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DESCRIPTION
OF
FARNAM'S
PATENT HYDRAULIC APPARATUS,
FOR
RAISING WATER;
INCLUDING
RULES, TABLES, PRICE LISTS AND OTHER PRACTICAL INFORMATION
ON THE SUBJECT OF
SUPPLYING FAMILIES, FACTORIES, TOWNS, CITIES, &c. WITH WATER.
ALSO, DESCRIPTIONS OF
FIRE ENGINES, FOUNTAINS, &c.

ILLUSTRATED WITH ENGRAVINGS:

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INTRODUCTORY REMARKS.

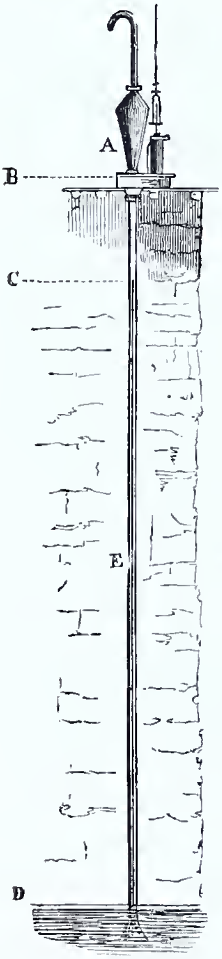
The author of this work having been for over fifteen years employed in manufacturing and putting in operation various hydraulic apparatus for raising water, and for other purposes, his time and attention were wholly devoted, during that period, to those branches of mechanical science, sparing no expense to bring into use the most perfect machinery for the purposes intended.

His object in the present publication is to explain the operation of pumps in different situations; the most approved plans of working them; the description of pumps best adapted for the various situations requiring them; the quantity of water discharged according to height, distance, and power applied; the quantity of water necessary to be used as a power to raise certain quantities of water to given heights and distances; and such general information as may be practically useful to persons wishing information, to enable them to secure a plentiful supply of water on their premises: together with remarks respecting draining mines and low lands; pumps for ships and steamboats; securing factories and other buildings against fire; supplying cities, villages, &c., with water, fire engines, fountains, hose, &c. &c.

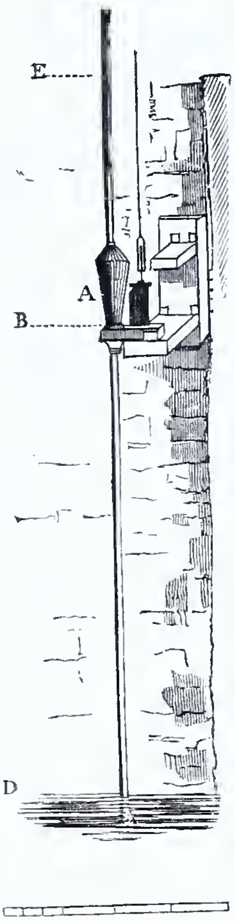
It may be proper here to state, that this work is not intended to enter largely into the subjects introduced, but merely to give, in as condensed a form as possible, such practical information as may be useful to both the person wishing hydraulic apparatus, and those putting it in operation.

ON ATMOSPHERIC PUMPS.

In the use of pumps placed above the fountain, and connecting with it by pipes leading either horizontally or perdendicularly, or both united, (the water to be raised by the pressure of the atmosphere,) it may be necessary to explain the reason why water cannot be raised by a pump, the buckets or piston of which are placed more than 33 feet, or thereabouts, in a perpendicular line above the surface of the water. Although the fact, perhaps, is known to most people, yet many do not know the reason why it cannot be done; and I have had applications for pumps, to be placed forty feet above the water, the applicants thinking that extra valves, placed at short distances, would enable them to raise water that height.



I will endeavor to explain the fact. Suppose a tube E, 36 feet in length, placed perpendicularly, the lower end inserted in the water, and the upper end attached to a pump B. The water within the pipe being on the same level as without. The pump, being put in operation, discharges the air from the pipe, and the pressure of the atmosphere on the surface of the water, which is 15 lbs. on the square inch superficially, being taken off the inside of the tube or pipe, the atmospheric pressure on the surface of the water outside drives the water up the tube. If the pump be capable of making a perfect vacuum, the water will rise about 33 feet within the pipe to C, and less, according to the distance above the level of the sea where the experiment is tried. The reason it will rise no higher is obvious: that as the water is forced up the tube by the pressure of the atmosphere on the surface of the water without, when the column of water equals in weight the pressure of the air on a surface equal to the base of the column within the pipe, the power that raised the water is expended, and one balances the other. The pump or piston being above the height that water can be elevated by the pressure of the atmosphere, it is plain that as the water can only rise to C, none will pass through the pump.



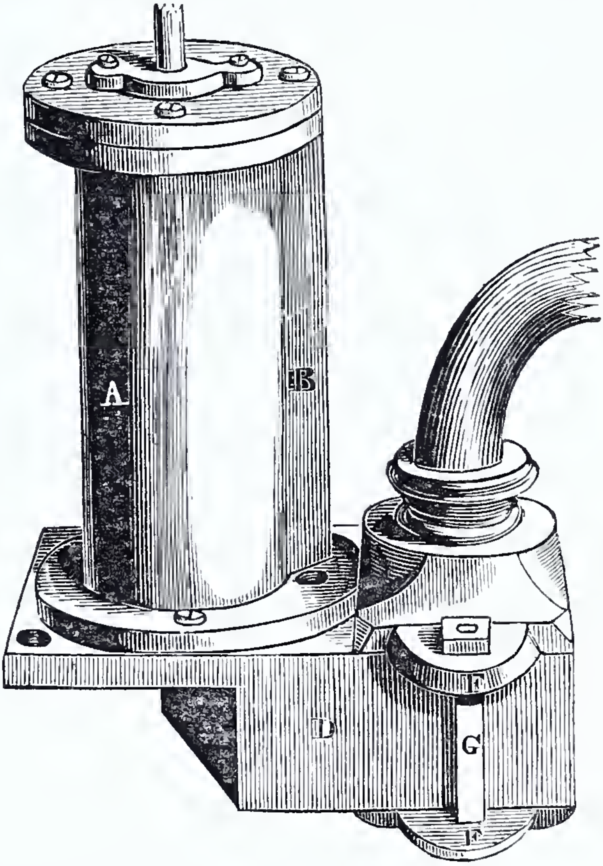
Now suppose we alter the position of the pump and place it within 25 feet of the surface of the water, and call E the extreme height that atmospheric pressure will raise water, and the pump A 25 feet, it will be perceived that, on working the pump, the pressure of the atmosphere will raise the water to E, and being raised once above the bucket, its elevation no longer depends upon atmospheric pressure, but it is then lifted by the piston or bucket; and the height to which it may be elevated depends upon the height of the tube, the strength of material, and the power applied.

I might here mention an error that exists, to a considerable extent, among those not conversant with hydro-pneumatic machines, or those depending on atmospheric pressure, that in a pump, the working piston or bucket of which is placed 33 feet above the water, will work as well, and raise as much water in a given time as if the working part had been placed at any distance nearer the water. The pressure of the atmosphere being equal to a head of water 33 feet, and as the quantity of water discharged from an orifice in a given time depends upon its elevation or head, it will be understood that the quantity discharged when the head is 33 feet is more than when it is only 10 feet. Now suppose you have two pumps, one placed 3 feet above the surface of the water, and the other 30 feet, it is apparent that the first will have, when the pump is in operation, 30 feet head (or atmospheric pressure equal to it) to supply it, while the second will have but 3 feet head; therefore the first may be worked with much greater speed than the second; and if the latter be worked faster than the head of 3 feet will supply it, all power applied beyond is wasted. For this reason pumps should be placed as near the water, perpendicularly, as circumstances will admit; and I would recommend 27 feet as the maximum under any circumstances.

Many persons suppose that a certain quantity of water raised per minute a given height, requires more power to raise it in a large pipe than in a small one, having, as they say, a larger body of water to lift. Instances are known where larger pipe above the pump has been taken off and smaller attached, for the purpose of "enabling the water to be raised with less power, as there will be less water above the box to lift!"

Water presses on all sides alike, according to its perpendicular height. A column of water 100 feet high would press on every square inch superficial 45 lbs. Now suppose the area of a piston to be 10 inches, the pressure would be 450 lbs., which would have to be raised in order to discharge water from the top. If the area of the pipe above the piston be 10 inches, the same as the piston, the water would pass upward with the same velocity as the piston; and supposing the pipe above the pump chamber to be 20 inches area instead of 10, it will be seen that the water need pass upward with only half the velocity as in the smaller size to discharge the same amount in equal time. Beyond the pressure of water on the surface of the piston, all we have to contend against is friction, and that is in proportion to velocity; and as the water passes up the large pipe with but half the velocity as up the small pipe, it will take less power to raise the same quantity in the same time. No matter how large the pipe above the pump, the pressure of water on the piston is no more when the pipe is 12 inches in diameter than when it is half an inch. Thus the larger the pipe used, both for suction and force, the less the friction, and, of course, a saving in power and strain on the pump and machinery. If any difference be made between the size of the suction and force pipe, the suction pipe should be the larger, particularly when the distance is considerable between the surface of the water and the valves of the pump. Generally my pumps are calculated to have the openings and connections to take pipe half the diameter of the pump chamber, viz: for a 4 inch pump 2 inch pipe is used, other sizes in proportion.

DOUBLE ACTION LIFTING AND FORCING PUMPS.



The pump represented by the above cut, adapted for nearly every situation for which a pump can be required, is a cylinder A and piston. The improvements over the ordinary cylinder and piston pumps are the arrangements of the valves and their covers, the bed and side pipe, rendering the pump double acting, and throwing the same quantity of water at the up and down stroke (excepting the diminution occasioned by the space occupied by the piston rod within the cylinder.) Two bolts G being removed, all the valves may be taken off for repairs or removal. The valves and packing under the top and on the bottom cup F, are united in the same piece of leather, and by unscrewing the valve weights, may be taken from the leather, and new leathers cut out by the old ones. The bed D being divided lengthwise, one pair of valves supplies the up stroke, and the other pair, by means of the side pipe B, supplies the down stroke, enabling the pump to keep a constant stream.

The advantages are—1. The little difficulty in getting at the valves for repairs, while all that is required to repair them is a knife, screw-driver and leather; and any one who can repair the buckets of a common old fashioned wooden pump, can more readily repair one of these.

2. The great advantage over single action pumps is keeping a column of water constantly moving, thereby working more easily and throwing double the quantity of a single acting pump of the same size.

3. By being placed in any required situation, water may be drawn from any distance and forced to any height or distance.

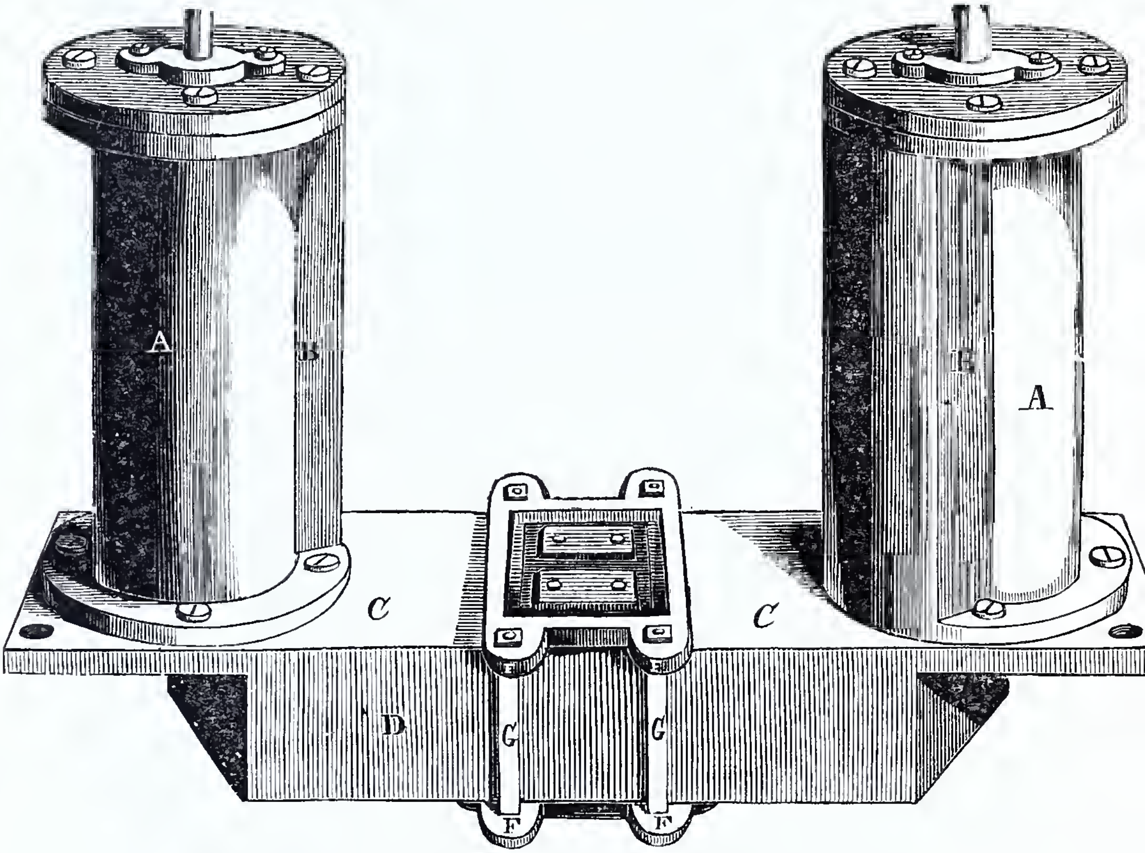
4. They may be used in all cases for a fire engine, as the smallest pump made will throw water over a three story building.

5. They may always be so placed as to be secure against frost.

6. The friction in a double action cylinder is but half that of the single action in proportion to the water raised.

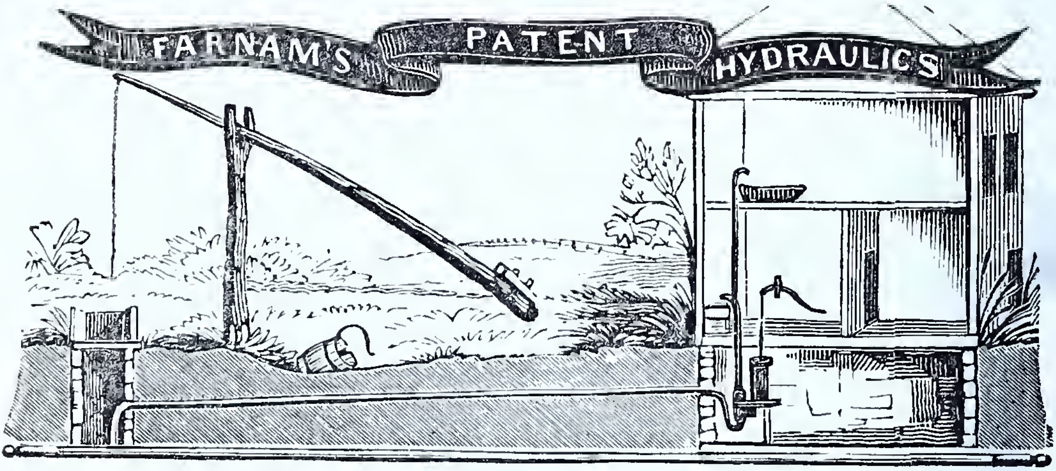
7. Owing to the simple arrangement of the pump, the price is less than that of any other pump that will perform the same amount of work.

8. The arrangement of the whole is so simple, that it is less liable to get out of order, and will keep in repair longer, and is better calculated for situations where mechanical skill is not readily at command, and where the most perfect and efficient machinery is required.



The above cut represents two cylinders on one bed. The difference between this pump and the one just described being the extension of the bed and adding another cylinder. The valves are the same, and both pistons draw in and force out water at the same time. These pumps are mostly used for fire engines, the capacity of the cylinders are required to be but half the size of those of other engines to throw the same amount of water. For ordinary purposes, the first described is preferable, having less friction in a pump of the same capacity. The valves are more readily got at for repairs, and one piston less.

PRACTICAL APPLICATION OF



The above cut shows a pump placed in the basement or cellar, the suction pipe leading from it through the wall and underground to the well, then down the well within 12 inches of the bottom ; the force pipe leading from the pump to the sink or basin above, whence the water discharges by a goose-neck, on the side of which is attached, by a coupling screw, a pipe leading to an upper room to supply a bath-tub. Such a pipe might be led to the upper part of a house to supply a reservoir, from which pipes could be led to any part of the house for shower-bath, water-closet, or domestic purposes. When working the pump, the pipe at the sink or basin being open, the water will be discharged there ; but if the water be needed in the reservoir, a cap is made to screw on the end of the goose-neck, which, stopping the water there, it will ascend to the reservoir.

When pumps are put up on this plan, if drawing any considerable distance, there ought to be a valve in the pipe a short distance above the surface of the water in the well. The valves I use for that purpose are brass coupling valves, with leather clacks, they being better than the poppet valves, as they leave, when open, a full water way. The poppet valve is so formed that the water strikes against a flat surface, causing more friction than the other, and is not so easily repaired. The wearing part of the clack valve being of leather, may be easily removed, requiring to be done only once in two or three years. The brake is attached to the wall or an upright post; the iron or wooden rod leading from the brake to the piston rod and the pipe pass through the floor at the end of the sink.

These pumps are 2½ inches diameter inside the cylinder, double action, drawing water the same up or down stroke, 6 inch stroke, and will raise from 10 to 15 gallons per minute, according to the height the water is required to be raised. The horizontal distance makes little difference. I have many in operation drawing water from 300 to 1300 feet, and some have been in use seven years.

The following is one of the many certificates that have been given me by those using my pumps:

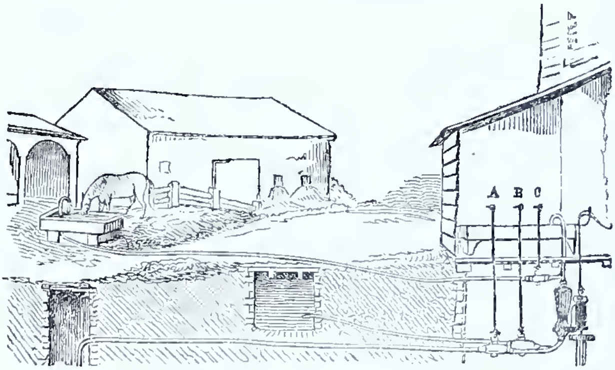
Cow Neck, Long Island, February 19, 1844.

This is to certify that I have one of D. L. Farnam's 2½ inch double action pumps, put up by R. L. W. Moses, which has been in constant use for the last seven years, drawing water from a spring 550 feet from my house where the pump is placed, and raising the water twenty feet, without obstructing its operation. I do fully believe them to be the cheapest and most durable pumps (and not liable to get out of order) that can be invented. I have fully tested its utility, and would not be deprived of the use of mine for $1000 if I could get no other of the kind. I do honestly recommend them to all persons, wishing to have their water brought cheap and easily, not to be without them.

WILLIAM L. BAXTER.

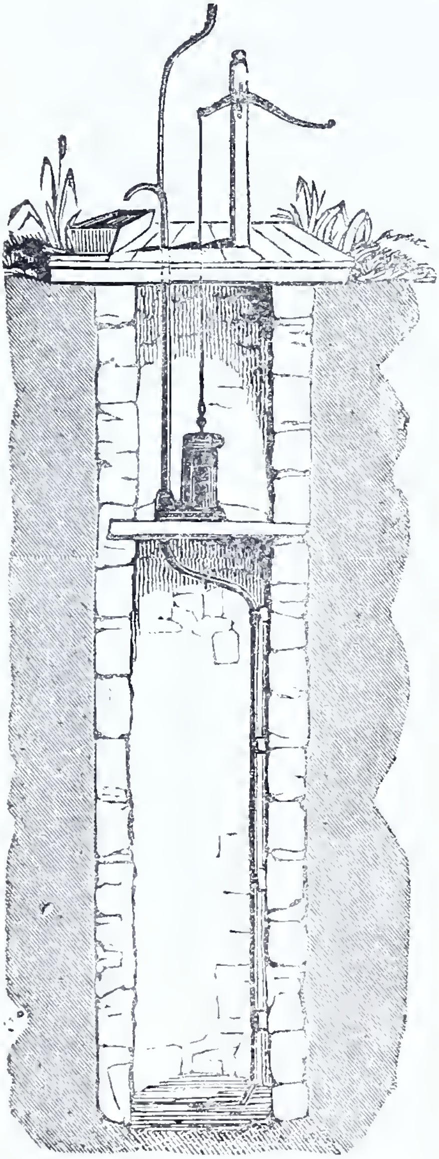
In northern climates it becomes necessary to place the pump and pipe so as to be secure from frost. At what depth the pipe ought to be buried to effect that, will be best known to the person for whom the work is designed. By placing the pump in the basement or cellar, three objects are gained: 1. Security from frost; 2. The pump will be better supplied by the pressure of the atmosphere; 3. By giving more length of pitman, (or connection between the pump and brake,) the motion is more perpendicular. In many cases it becomes necessary to put the pump down, in order to bring it within the distance of 25 feet perpendicular above the water, which allows a pump to be used in situations where it otherwise could not if placed at the point of discharge or basin. To the screw on the end of the goose-neck may be attached hose, and with a branch pipe at the other end, you have an engine on a small scale, which will throw a quarter of an inch stream over an ordinary two story house.

When used as a fire engine an air barrel is useful to keep up the pressure while changing the direction of the piston.



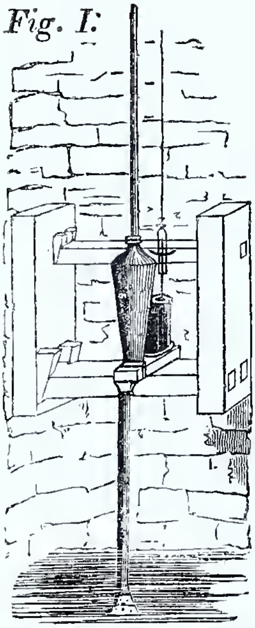
The above cut shows a mode of attaching pipe for conveying water to a barn or out buildings, for the purpose of watering cattle, to a garden or to a reservoir supplying a fountain, &c. Immediately over the air vessel attach a branch pipe with a cock, and rod fastened to the stem of the cock. The pipe may pass out the same opening in the wall that admits the supply pipe, thence leading to the barn or reservoir. If the place where the water is wanted be higher than the place of discharge in the house, a cap must be screwed on the end of the goose neck. Place half of a hogshead at your barn, on the ground, and let the pipe come up perpendicularly through the centre, and nail a piece of leather on the bottom inside, so that it may shut over the end of the pipe, forming a valve to keep out dirt. The tub being on the ground will protect the pipe from frost, the centre of it at the bottom being the last place that will freeze.

Water can be drawn from a well or spring, and from a cistern by the same pump. Immediately below the pump (see cut) the pipe branches and a cock is placed in each pipe. A and B are rods conveniently placed for opening the cocks. When cocks are used for suction pipes, they must be of the best kind, as a leak will affect the working of the pump; I would not, therefore, recommend this plan when the distance from the pump to the water perpendicularly is more than twenty feet. It may be proper here to state that no horizontal distance is too great to draw water and work the pump by hand, if the perpendicular distance between the level of the water and pump be not over twenty-five feet.



Here is represented a hand pump placed in a well of moderate depth not exceeding thirty feet, with the supply pipe leading down the side of the wall, and secured by driving wooden wedges in between the stones, and iron staples driven over the pipe into the wedges. This pump is represented as being placed on a stick of timber let into the wall; but it is not a good method, owing to the difficulty of permanently fastening a timber in a wall of round stone as wells are generally built. I prefer fastening the pump on a frame (see fig. 1, on next page,) the cross pieces being fitted into the uprights, diameter as great as will pass down the well, and when lowered down to its proper place, keys to be driven in at the shoulders of each tenon, driving the uprights out against the wall, which if well done, and the walls strong will hold all firm. Or, the pump may be fastened on a thick plank or piece of timber, and lowered down into the well and braced against the wall, by scant-

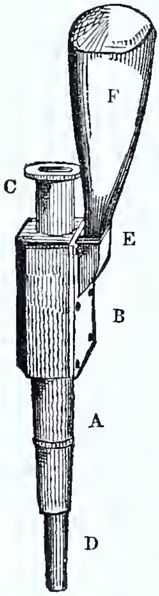
Fig. I:



ling leading diagonally upward and downward, which being firmly driven and secured in their places, will make it sufficiently strong to sustain the action of the pump.

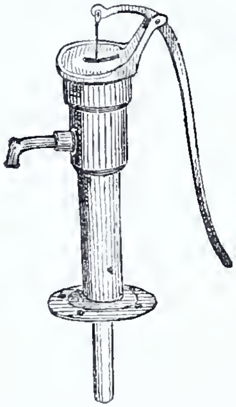
When pumps are required for wells from 30 to 80 feet in depth, I use a 3 inch double action pump, made extra strong, and so arranged that the valves may be taken out of the pump by removing two plates in front, secured by two screws each. The valves may be taken out and a new set supplied in fifteen minutes, which requires to be done not oftener than once in two or three years.

When required for wells from 80 to 180 feet deep, I use a cast iron lift pump, as shown in the annexed cut. This pump is made of cast iron. In the chamber A is inserted a brass chamber, 4 inches diameter inside and 17 inches long, in which are brass buckets, on the upper one of which the pump rod is keyed. The front of the pump above the chamber has a plate B fastened with 6 bolts, by taking off which, the buckets can be taken out when repairs may be necessary. The socket C at the top and tube at the bottom are made to fit 3 inch cast iron pipe, such as is used in city water works. On the front of the plate is a flanch E, with a copper air vessel F attached. These pumps are of the most durable character, being entirely of metal, except the valves and piston or bucket leather, which are the only parts liable to wear, and by means of the door or front plate they can be easily renewed.



They are better calculated for deep wells than any pumps now in use. The air barrel tends to keep the upward column of water, when the pump is at work, in motion, thus enabling the pump to be worked with less power. In the ordinary lift pump, the column of water stops at every down stroke of the piston or bucket, and every up stroke has to act on a column of water at rest, which requires extra power to put it in motion. The increase of power necessary to start a balance wheel over that required to keep it in motion when it is going, will show the difference between starting a column of water and keeping it in motion after it is once under way. These pumps, for domestic purposes, may be worked by children ten years of age, even when drawing water from wells 150 feet deep. Of course the brake or lever for working the pumps must be long, and the quantity of water raised proportionally small.

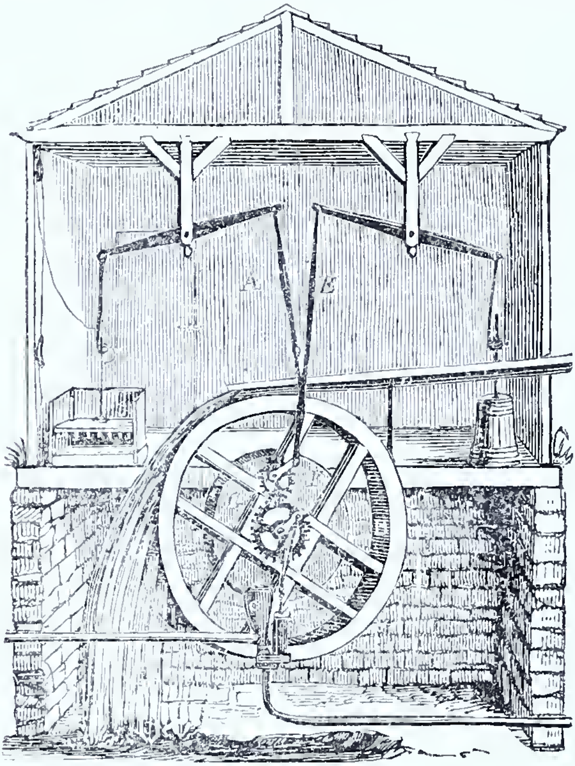
The chamber and the buckets ready to attach to the rod, and the air barrel, weigh 180 lbs., and can be furnished complete; and those disposed can attach wooden or iron pipes between the pump and head, the iron part being placed near the water. I have now one in use in Jamaica, Long Island, in a well 137 feet deep, working by a horse, that raises 20 gallons per minute, for supplying a starch factory. Another at Flushing, Long Island, in a well 73 feet deep, worked by hand—a person of ordinary strength raising 15 gallons per minute.



When a cheap cistern pump is wanted to raise water from 10 to 15 feet, an iron pump of the description here shown answers a good purpose. The first cost is small, and with $1\frac{1}{4}$ inch lead pipe they work very well. Most of them are so arranged, that by raising the brake to its extreme height, the valves are opened and the water runs back into the cistern. The objection is, when they are put up exposed to the weather in northern climates, the raising of the brake is generally omitted in *very* cold weather from haste to get into warmer quarters, and the pump probably ruined. They should, therefore, be put up in the house, where the liability to frost is not so great.

The pumps previously spoken of being for wells and springs, and calculated to supply the ordinary consumption of families, I will now introduce the plan of obtaining water from springs or streams through

PUMPS WORKING BY WATER WHEELS.



The above cut presents a sectional view of a small building covering a water wheel. To the shaft of the wheel a crank is attached by a shackle bar to the piston rod of the pump. The shaft on the opposite side of the wheel carries a grindstone; above, to the right, is a churn; at the left is a box for cleansing clothes, to which is attached a steam apparatus. This cut represents the works of Winthrop Phelps, Esq., of Chatham, Columbia County, New York, put up in 1839, a description of which is given by Mr. Phelps in the "Cultivator," vol. vii. No. 11, as follows:

" For the benefit of those farmers and others, situated as I have been, without the conveniences of good water near my premises, I would state that in November, 1839, I engaged Mr. D. L. Farnam, of 247 Water street, New York, to put up an apparatus that should enable me to have water at my house, barn, &c. I had a spring of excellent water 400 feet from the kitchen, that discharged 30 feet lower than my house. I had, in the meadow above the house, several small springs that discharged together a small but constant stream during the year. The plan was to use the water of the latter to force up the water from the spring to those places where I wanted it. For this purpose I put up a building 12 feet square, standing on a stone wall about 5 feet high. This building was placed about 200 feet from my house on the low ground between the spring and house. In this I put a water wheel 9 feet diameter and 12 inches wide. The water was brought along the side hills from the upper springs, and, by a spout, carried on to the wheel. An inch lead pipe was laid from the spring to a small double action pump, attached to the wheel shaft by a crank, as seen in the cut, thence leading under ground to a reservoir adjoining my milk house, within 20 feet of the kitchen door; from this reservoir a pipe leads to the kitchen, and discharges into the sink by a cock. From the reservoir I convey water on to the shelves in my milk room, they having a raised edge, so that at pleasure I have water running one inch deep on each shelf, to keep the milk cool in warm weather. Likewise from the reservoir I have a half inch pipe laid to my barn yards, 15 rods farther, and a pipe running to the hog pen, keeping a constant supply. Attached to the water wheel is a grindstone, and machinery to do our churning, which we have used through the season. The apparatus marked A is the plan I intended for pounding clothes. With the addition of a steamer it would save much labor to the women, and the same steamer might be used to steam hay, potatoes, corn, &c., for cattle and hogs. My water works continued to work well all last winter, without in the least being affected with frost. The quantity of water thrown up is about 6 gallons per minute, and has required, since put in operation, but a few moments' attention once a month, to tighten the packing around the piston rod, and oiling. To those situated as to water similar to myself, I would say that the cost of the water works is a small consideration compared to the advantages. I shall be happy to give any information that may be wanted, or show my works to any disposed to call and examine them.

" WINTHROP PHELPS.

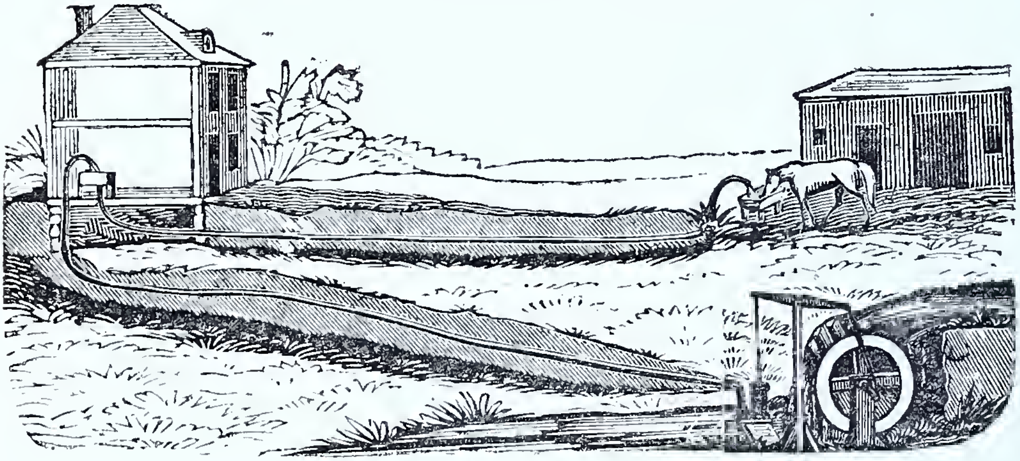
" Chatham Centre, Columbia Co., N. Y., September 23."

The quantity of water used to work the wheel was small, the whole of it coming from a few springs in a meadow some three hundred feet from the place where it was conducted to the wheel.

Running streams where a head of 3 feet can be had, with a flow of 50 gallons per minute, will answer to raise 1 gallon of water per minute up a perpendicular height of 100 feet. I have put up small pumps forcing water through 380 feet of pipe, 40 feet rise and a head of 30 inches, with the water of a small brook, giving at the place of discharge 6½ gallons per minute. When the quantity of water is small to work a wheel, the quantity raised will of course be proportionally less ; but even a gallon per minute amounts to 1440 gallons per day. This quantity conducted into a reservoir to be drawn from for domestic use, will furnish an ample supply for keeping clean clothes and faces for a pretty large family! It is not necessary that the spring or source from which the water is drawn should be in the immediate neighborhood of that to be used for power, as the water to work the wheel may be conveyed in many cases to the vicinity of the spring, or by pipes the water from the spring brought to the pump. In some instances the water to work the wheel and supply the pump can be drawn from the same source, when the quality of the water is satisfactory. On the opposite page I give a table of the quantity of water that can be raised or forced up by using a water power and wheel. The variation in the quantity of water in different situations likewise in the fall and height required, would render a table to answer all purposes, too lengthy. The following, however, is an easy method by which any one can ascertain the required quantities: divide the diameter of the water wheel—if overshot, or the fall of water, if breast wheel—by the height the water is to be raised; divide the result by the quantity of water your fall will give per minute, and you will have the quantity your power will raise, provided you had no friction to contend with; what this may be depends on the quality of your machinery, the arrangement, the size of your pipe, and the distance horizontally you force the water. One-third less than the quantity found by your figures is perhaps the best data—but if your machinery be of the best kind the result will be more favorable.

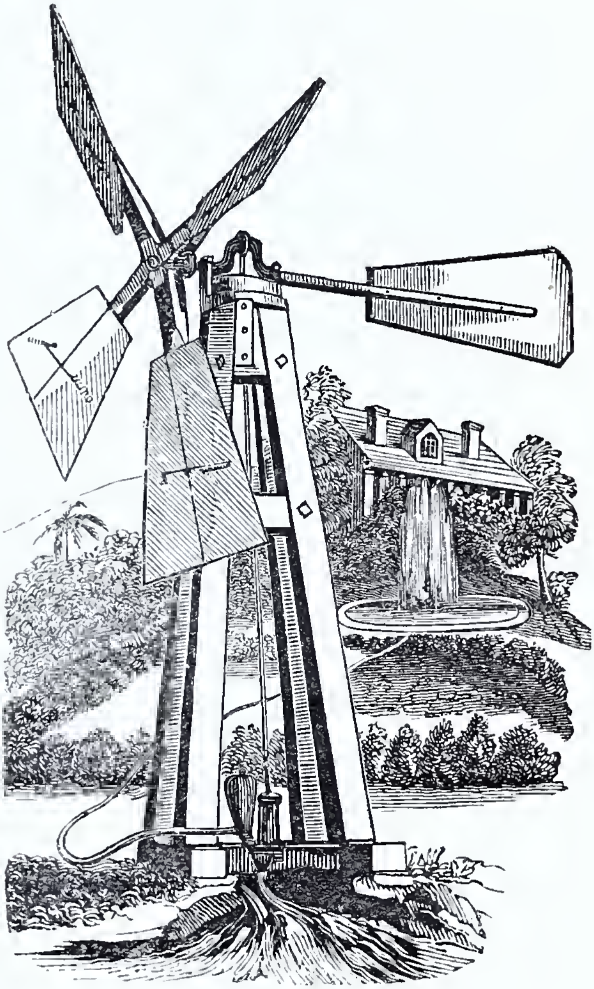
Supply of power. Galls. per minute.	Fall.	Feet to be raised.	Gallons per minute.
50	5	40	6¼
60	6	40	9
70	7	40	12¼
80	8	40	16
90	9	40	20¼
100	10	40	25
110	11	40	30¼
120	12	40	36
130	13	40	42¼
140	14	40	49
150	15	40	56¼

Persons having small streams of water that they can make a temporary dam across, and insert at the top a spout that will let *all* the water pass through it, may, by having a hogshead, box or tub placed under the spout, determine the quantity of their spring or stream will give per minute; or when the stream is too large to be managed as above, and not too large to be contracted and made to pass through a spout or floom—of any width so that the bottom be level and the sides perpendicular—take the depth of water, the width of spout or floom and multiply them together—and get the number of feet the water moves per minute, and you can find the number of cubic feet of water that passes per minute—a cubic foot of water weighs about 62½ lbs. and contains about 7½ gallons, wine measure. The velocity of the water will be rather more in the centre on the top than an average—so it ought to be tried near the edge and centre, dividing the difference. A cork with something suspended reaching near the bottom, will answer to determine the velocity.



Here we have a pump worked by a wheel conveying water to a building and kept constantly turning, doing away with the necessity of a large reservoir. The water passes into a small reservoir, and is discharged from the end of a pipe or goose neck. To prevent the reservoir overflowing, a pipe passes down through the bottom, leading to the barn yard or any place required, the top of the pipe rising to near the level that the water is wanted in the reservoir. The above cut is only intended to show the general plan; the details of arranging the work to the best advantage are contained in other parts of this work.

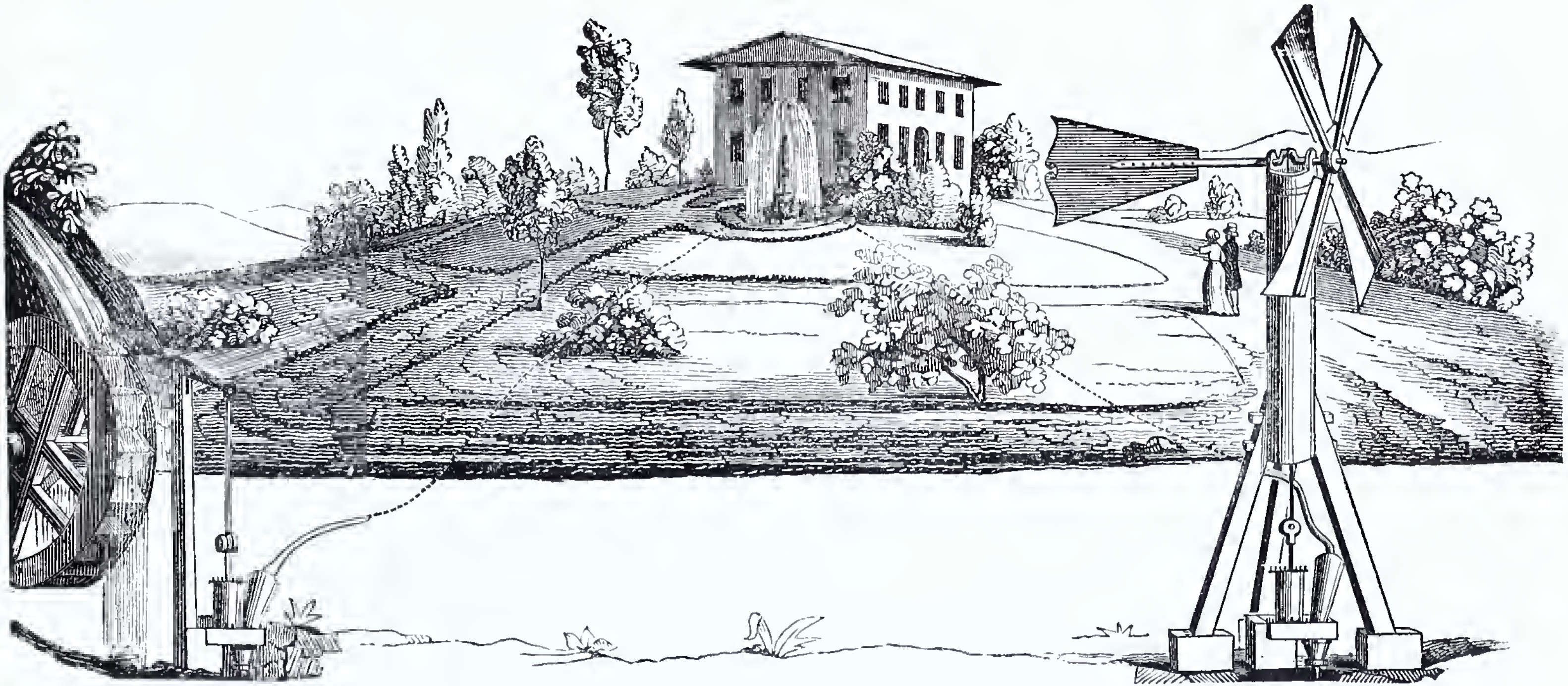
It will be perceived that a walking beam is used to work the pump. When the wheel is small and there is not room to put the pump below the crank, a walking beam becomes necessary, unless it be preferred to place the pump horizontal, or at an angle of 90 degrees, in which cases the air barrel must be made to suit the situation, as it is required to be perpendicular. The pump will work equally well in a horizontal, diagonal or perpendicular position.



This cut represents a wind mill working a pump, taking water from a spring and forcing it to a fountain. A fountain would not play very steadily depending upon wind alone for its power, but the engraver took a " short cut " and left out the reservoir. Wind mills may be worked to advantage in many situations where nothing better can be had. I have found with a reservoir of three times the capacity of what may be wanted, for a daily supply, there would be with a wind mill of sufficient size, little danger of being out of water. It is necessary when a wind mill is used to place it in a position that it may be acted on from all parts of the compass, unless when winds blow more generally from particular points, as trade winds. This may be done by placing it where the ground is generally level and clear of trees, or by raising it on a frame, or on a building. These mills work on two iron rings, the inner one being attached to the post or frame, and the outer one to the boxes in which the crank shaft revolves. The arms that support the wings are bolted in iron flanches keyed on the shaft; the vane arm is bolted in a flanch attached to the outer ring. The great objection generally to a machine being worked by wind is the unsteadiness of the power, varying from stand still to the greatest velocity, at which speed it is liable to injure any machinery attached to it. As a mill for raising water would be too expensive, to have a man constantly attend to it, I make the wings with joints, according to the line seen in the cut. The projecting half of each wing is sustained in its position by hinges and springs, which yielding to a high wind, it is brought to more or less of an angle to the other half, thus modifying the velocity and preventing too great a speed. When the wind is not too strong, the springs draw the wings to their places, and they "go on their way rejoicing."

In the foreground of the view on the opposite page is seen a small mill, fixed on the top of a pump log. The rod passes down the opening, allowing the mill to veer round to the wind without turning the rod connected with the pump. A few feet lower than the crank is a double joint, below which the rod passes through a guide, allowing the rod above, connected with the crank, to vibrate and turn around at the same time. Machines of this kind must be kept well oiled, or they will wear out fast. I place cups for holding oil over each box—the oil supplied by lamp wick, and the cups holding a gill each, which will last from 8 to 10 days.

These mills would do well on a farm for raising water from a well for the supply of cattle or stock, a basin being prepared

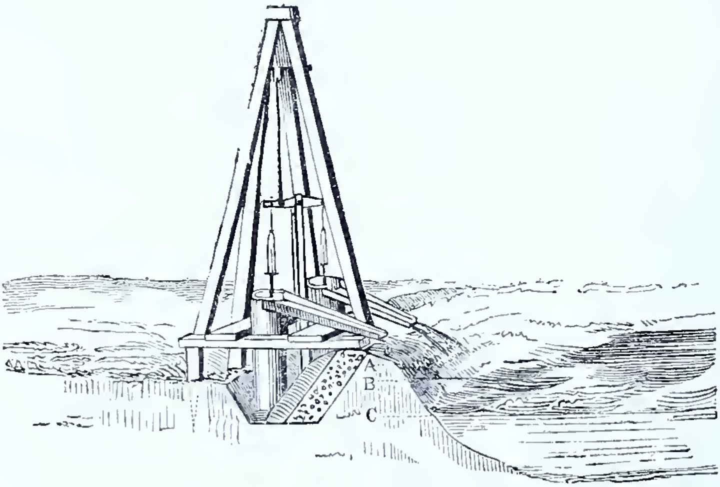


Water supplied to House, Fountain and Garden, by Water Wheel and Wind Mill.

on the surface of the ground and puddled with clay to hold the water. They are used for raising water for tan works, turpentine distilleries, salt works, for irrigation, and are particularly useful for

DRAINING LOW LANDS.

This subject is important, not only to those having lands of this description, but to the public at large, as millions of acres of as rich land as the best in the country—land for many feet below the surface composed of vegetable mould—are now of little or no value, or only used to grow an inferior kind of grass. In many situations, the expense of ditching and dyking would be but a small per centage on the increased value; and these are often done imperfectly for the sole purpose of securing crops of inferior grass, when a little more outlay would make the land fit for any farming purposes. In order to do which, the dykes or embankments generally ought to be made entire, water tight, without sluice ways, and secured against the depredations of muskrats or other vermin, (the great enemies of water embankments,) by facing with gravel, and covering the gravel or sand with the soil taken from the ditch.



In the above cut the dots between the two parallel lines represent the gravel. The letter C marks the line of low tide; B high tide; A spring tide, which but for the dyke, would over-flow the land. Muskrats or other vermin will not dig in gravel; and a broken dyke that lets in salt water on land under good cultivation, is a serious affair. It is a matter of economy to have the work well done in the first instance.

Draining by Wind Mills.—Respecting the draining of lands, after the dykes are well secured, so as to keep out all the salt water, it becomes necessary to adopt some plan to get rid of the superfluous fresh water from springs, streams or rain. To do this, I would recommend one or more wind mills; two mills are best in all cases—should any accident happen to one, the other will prevent injury while the damage is repairing. As the height at which the water is to be discharged over the dyke would be small, the best pumps for the purpose would be plain cylinders; if of wood, made square; if of copper, round. Two pumps would be necessary for each mill, that the up and down strokes might be equal. The rod from the crank may be attached to a walking beam for working both, as in the cut.

Mills for this purpose are used in Holland, where the sea is often higher than the country; in England, and more or less in other European countries.

In the vicinity of New York are extensive salt marshes, which are generally dyked and ditched sufficiently to grow salt hay. Were the salt water kept entirely off the soil, and the fresh water kept down eighteen inches below the surface, with frequent ploughing and the use of lime, the soil would soon become light, free from the effects of salt, and fit for any kind of grain, vegetables, or fruit. Some one has remarked that he who makes two spears of grass grow where but one grew before, is a public benefactor—then, certainly, he who reclaims the marsh, swamp, or bog meadows, from a state of little or no value, (often indeed, causing disease and death from their unwholesome exhalations,) and makes them produce largely of sustenance for man and beast, must truly deserve the thanks of his fellow man.

I manufacture mills that, with a fair breeze of wind, will raise from 200 to 500 gallons of water per minute.

HORSE POWER.

In many situations a pump, reservoir and horse power can be made very useful. A person wanting a large quantity for daily use, for domestic purposes, bathing, green houses, watering gardens, cattle, or for fountains, can, by means of a horse power, raise, in a short time, into a reservoir a large quantity.

Table giving the quantity of Water raised by one Horse per Minute and per Hour from 1 foot to 100 feet.

Feet.	Gals. pr. Min.	Gals. pr. Hour.	Feet.	Gals. pr. Min.	Gals. pr. Hour.
1	4,400	264,000	31	142	8,520
2	2,200	132,000	32	137.5	8,250
3	1,466.6	87,996	33	133.4	8,004
4	1,100	66,000	34	129.5	7,770
5	880	52,800	35	125.8	7,548
6	733.3	43,998	36	122.3	7,338
7	628.5	37,683	37	119	7,140
8	550	33,000	38	115.9	6,754
9	488.9	27,334	39	113	6,780
10	440	26,400	40	110.1	6,606
11	400	24,000	41	107.5	6,450
12	366.6	21,996	42	104.9	6,294
13	338.4	20,304	43	102.5	6,150
14	314.3	18,858	44	100.1	6,006
15	293.3	17,598	45	97.9	5,874
16	275	16,500	46	95.8	5,748
17	258.8	15,528	47	93.8	5,628
18	244.5	14,670	48	91.8	5,508
19	231.6	13,896	49	90	5,400
20	220	13,200	50	88.2	5,292
21	209.6	12,576	55	80	4,800
22	200	12,000	60	73.3	4,398
23	191.3	11,479	65	67.6	4,056
24	183.4	11,004	70	62.8	3,768
25	176	10,560	75	58.6	3,516
26	169.3	10,158	80	55	3,300
27	163	9,780	85	56.8	3,108
28	157.2	9,432	90	48.8	2,922
29	150.8	9,108	95	46.3	3,778
30	146.7	8,802	100	44	2,640

Raising Water by Horse Power.—Having a pump of sufficient capacity for two horses, the same quantity of water can be raised in half the time that one can do it; but one horse can work the same pump as easily as a smaller one, if the stroke of the pump be shortened so as to bring the quantity within his power, which can be readily done by having the crank pin so fixed that it may be taken out and placed in a hole prepared for it nearer the centre, so as to give the requisite shortness to the stroke.

Horse powers should be strong, and every part of the work well made, as all unnecessary friction is so much loss of power; and to work a pump, they should, in all cases, have a balance wheel to regulate the motion, as without one the draught is unequal, and the jerking movement produces unnecessary wear, both of horse and machinery—while unequal motion, being more liable to break the parts, calls for more strength in them, and consequently expense.

Machines to work pumps are generally calculated to be stationary, and can be made on more simple plans than those that are intended to be moveable.

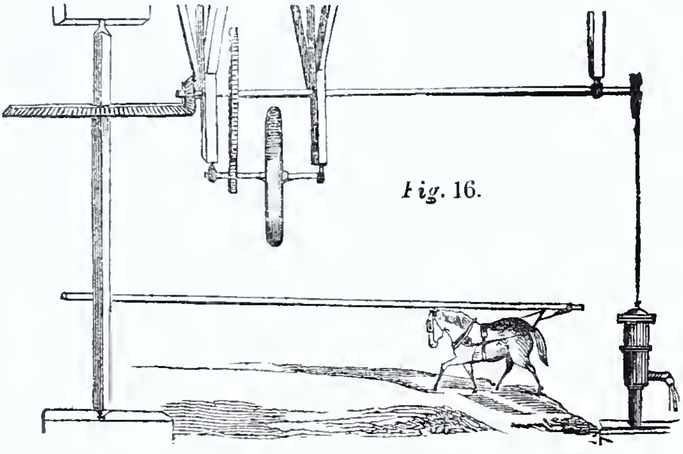
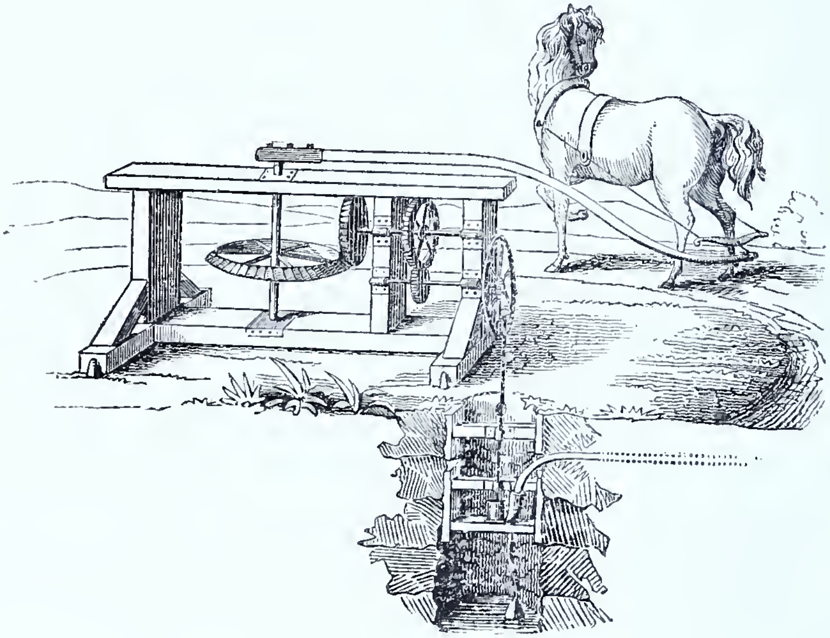


Fig. 16.

Here is a plan of one now in use for raising water 137 feet, to which is attached a pump, as described (page 16) under the head of lift pumps, for drawing water from wells 80 to 180 feet deep.

Another plan of a horse power is here given, which may be preferable in many situations. The drawing, however, is incorrect in one particular; the balance wheel, which is represented outside of the frame, ought to be between the posts, and the rod to connect the pump with the machine ought to be attached to the crank on the upper shaft; because the speed of the balance wheel on the shaft, as represented, would not be sufficient unless it was very large. The circle for a horse to travel in, to work a power to advantage, ought to be 25 feet diameter, and a horse will pass around on an average about three times a minute. In order to get 25 revolutions to the crank, the large wheel must be eight times the diameter of the small one, or 8 feet and 1 foot, if of cast iron. But if made on the plan represented in cut, Fig. 16, the large wheel may be made of wood with iron segments. In that case it would be well to make the large wheel 12 feet and the pinion 18 inches, as the friction is less as the pinion is larger.

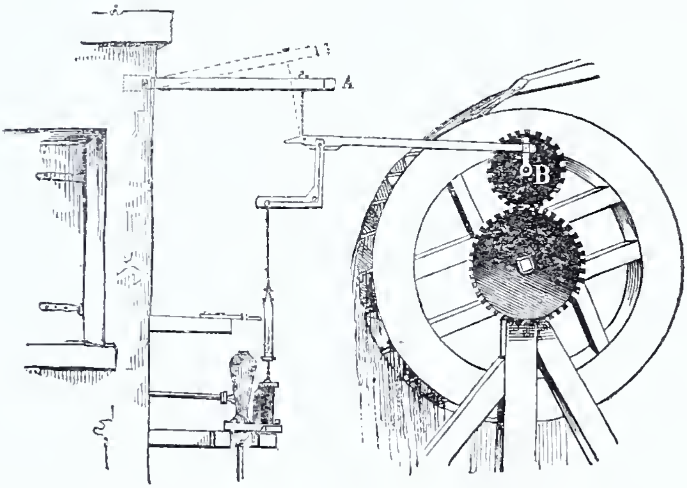


PUMPS FOR FACTORIES.

As an introduction to the subject of pumps for factories I here insert a letter received from Mr. Robert Rennie, of the Lodi Print Works, near Belleville, N. J. who has twice saved his factory from fire by means of a pump fitted up for that purpose. He has 150 feet of leather hose, and branch pipe that will deliver 1¼ inch stream. He has also a 2½ inch pump, which forces up water to his dwelling house at a considerable elevation. It supplies his premises with water and keeps a cast iron fountain playing at the same time. Mr. Rennie has had five pumps of me, all of which are now in operation on his premises.

"Mr. Farnam:

Dear Sir—In reply to your inquiry of how I had geared the pump I bought of you four years ago, I enclose to you the accompanying pen sketch of the fixtures. By moving the wooden arm A, I can put it in gear instantly. I have had occasion to use it twice since I put it up, and in both instances it saved a large amount of property. I work it 60 double strokes per minute; that is, the wheel B makes 60 revolutions; I can throw a stream of water out of a 1½ inch nozzle over my highest buildings, 50 feet high.



I use it occasionally to see if it is in good order, and in no instance have I found it to fail, but at all times fit for duty, if kept free from sand or gravel under the valves. I have also less difficulty in effecting insurance now than previous to getting the pump.

I have much pleasure in testifying to this, and I hope it may be of some service to you. I do not think any considerable factory should be without one.

I am, yours, &c.
ROBERT RENNIE.

Lodi Print Works, N. J., Feb. 19, 1845,"

Factories may be insured, but no one expects to obtain by insurance the full amount of damage for loss of business, &c.; and when supplied with proper machinery to guard against damage by fire, they may be insured for a small amount, sufficient to cover any probable damage, or obtain their policies at a much reduced rate. Either way a great saving will be made. There are a variety of methods to arrange the machinery for the purpose intended. I have had pipes connected with the pump leading perpendicularly up within the buildings, and opening in each loft, either of which might be opened from the outside, the upper one being open at all times. In other cases the water is raised into a reservoir formed for the purpose on the high ground near by, and fire plugs in front and rear of the buildings to connect hose. By means of ladders permanently put up alongside of the building, several streams might be thrown into any part of the building. A reservoir of proper elevation, containing 50,000 gallons, with the operation of the pump would be sufficient to put out any fire in the building, even if well under way. The reservoir, by means of pipes, might supply dwellings adjacent with water for ordinary purposes. One is in operation on the above plan for E. Gray, at Ellicott's Mills, Md., raising 75 gallons per minute, 150 feet high into a reservoir on a hill in the rear of his factory—the pipes are connected with two fire plugs in rear and one in front.

Mr. Rennie's plan of using merely the pump and hose direct, he has found efficient in two instances. He stated to me that being in bed, in three minutes from hearing the fire bell, he had water on the fire, and extinguished it in a few minutes.

PAPER MILLS.

Seven paper mills have 6 inch pumps for drawing and raising water for their business, and all so arranged as to be used in case of fire. When pulp is required to be raised, these pumps answer the purpose without its clogging or interfering with their working.

TAN WORKS.

I have many in operation for tan works for drawing water and raising the tanning liquor to the leaches, after passing from the vats to the cistern. Two pipes pass from below the pump, one to the water fountain and one down to the cistern. These pipes connect to a valve box and by slides either liquor or water can be raised. The pumps for this purpose ought to be of brass, as iron colors the tanning liquor. I have made several of iron and lined the cylinders with copper and faced the valve seats with brass, which give full satisfaction. They are working in various ways, by wind mills, horse, water and by hand.

BREWERIES.

These pumps are admirably calculated for forcing water through pipes for cooling the beer, as well as raising water for the ordinary supply of the brewery.

SOAP BOILERS.

I have supplied soap boilers with pumps for raising hot ley. When used for this purpose they are made without any leather, and calculated to withstand any boiling liquid.

HOT WATER.

Pumps for bathing or other purposes requiring hot or warm water, are made in the same way as those last named, all of hard metal, except the joints, which are of lead or canvass.

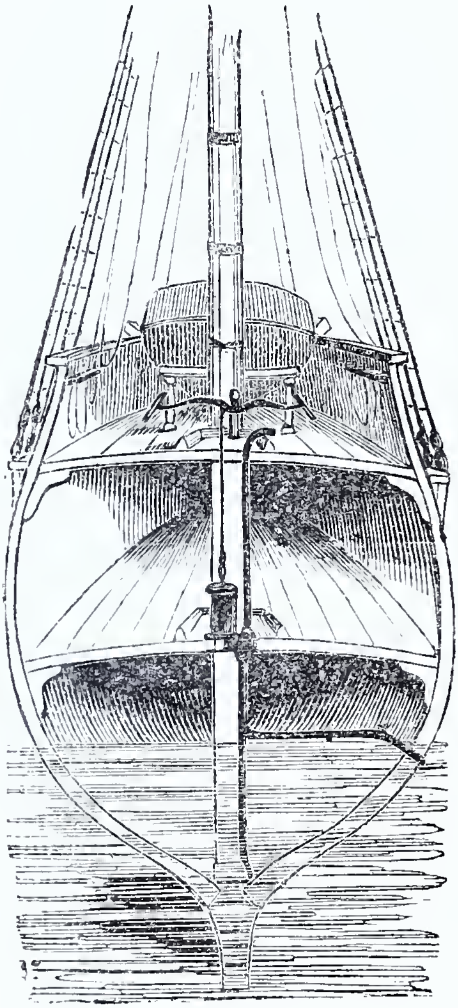
MINES.

Several pumps are in operation that I furnished for iron, copper and other mines. One for a copper mine in Cuba, raises 400 gallons a minute 150 feet, worked by a steam engine; several in Jersey worked by horse power; one for a coal mine, worked by a water wheel; several in Mexico, worked by mules.

Pumps for mines ought to be of the most simple and efficient kind. The valves should be so arranged that in a few moments they may be taken out and new ones substituted. As few bolts as possible ought to be used and those of great strength. Miners are not generally mechanics, and where engineers are employed it is seldom much time can be spared to keep the pumps idle for repairs—and it becomes of importance to have the pumps, and machinery to work them, as little complicated as possible. For mines, the pumps I make are so arranged that the valves may be got at without disturbing the pump or pipes—the openings to get at the valves being covered with a cap and secured by two bolts; these being removed the old valves may be taken away and new ones inserted in a few moments. The pumps being double action they raise water up and down stroke alike—and one cylinder pipe and pitman—answers all the purposes of the complicated machinery that is often imposed upon merchants supplying mines—in some cases three single action cylinders or pumps, three pitmans, three throw cranks—all this mass of machinery for the simple purpose of raising water! Persons must be *green* who buy such machinery to send into mining districts, at an expense of more than double what good and efficient articles may be had for. Hydraulics is a science that requires as much study and practical knowledge as any other, and those who make it a mere appendage to their business seldom become competent to recommend the proper machinery for raising water any considerable height or in large quantities; it requires not only theoretical but *practical* knowledge to become an Hydraulic Engineer.

SHIP PUMPS.

Here is a vertical section of a ship, showing a pump on the berth deck, a pipe leading down into the run, and continued above the pump to the deck of the ship. The pump is worked by a double brake, with poles at each end of sufficient length for 8 or 10 men. A pipe leads from the pump below the berth deck, alongside the carline through the side of the ship. A cock or slide valve is inserted in the pipe near the ship's side. To the pipe immediately above the upper deck is attached by a screw, a copper goose neck having a male screw on the end. The goose neck and screw for the purpose of attaching hose for washing decks, filling water closets, reservoirs, cleansing the hold, filling casks for ballast or for wetting sails. The pump with 8 men will throw water to the skysails of the largest ships. For all the above purposes the cock or slide valve in the side of the ship is opened and the water drawn from overboard. When the valve is closed the pump may be used to clear out the ship as ordinary pumps. A pipe may be connected with the pipe above the pump and that which passes through the side of the vessel, and in case of a leak in the ship, the water can be discharged on a level with the water on the outside, instead of raising to the upper deck as



now done—a saving of half the power necessary to clear the vessel. The gooseneck unscrews even with the deck, and is only employed when hose is used or for filling pails. The brakes unship and may be put against the bulwarks out of the way.—A single brake for one or two men may be used ordinarily.—Ship pumps of the kind in general use are of wood, and from 4 to 5 inch chambers, and are only used for clearing the ship when she leaks. Other pumps are used for other purposes, for head and stern pumps, and many East India ships carry engines purposely for wetting sails, &c. One double acting pump of the size of the old fashioned wooden ones will throw more than double the quantity of water and may be used by one man or by the whole ship's crew, and will perform all the duty of head, stern and centre pumps, and engine; while it is more easily kept in order and takes up less room, and what is of the utmost importance, in case a vessel spring a leak you have something to depend upon to keep the ship clear.

While writing the above, fire engines are passing down to the ship Montezuma, which has taken fire from the cook's galley. This circumstance shows the important use that might be made of a pump as above described in case of fire in the ship. Many a vessel has been lost, and no one left to tell how. May not some of them have been destroyed by fire? We know that many have been thus destroyed. By means of hose and a branch pipe, water may be thrown into any part of a ship's hold on fire without opening the hatches, and fire may be easily extinguished while in a smothered state before air is admitted. I think pumps of this kind, fitted on board ships, a means of perfect security against fire, either alongside the wharf, at anchor, or at sea. With a little practice, the brakes may be fitted, hose connected, and water thrown in any part of the ship in 30 seconds. In 1833, I saw a brig, with a valuable cargo on board, 150 miles east of the Capes of the Delaware, deserted in consequence of her springing aleak four days out of this port. I was on board of her some time, and am satisfied, that with a pump as above described, we could have brought her into port. This is, probably, only one case out of many where vessels are lost for want of proper machinery to meet those emergencies to which all ships are liable.

STEAM BOATS.

Twenty-seven steam boats in this harbor have 4 or 5 inch pumps for washing decks and for fire engines. They are generally placed so that the brakes are on the upper deck, forward, to be out of the way of freight or interference from passengers in case of fire; the pump to be placed below deck, and the pitman and pipe passing up through the upper deck. When the brakes are likely to be in the way, they are made to unship, or with joints to let them drop down. Hose, branch pipes, couplings, copper pipe, &c., furnished complete.

Pumps fitted up on steam boats in the manner described, are very useful for *many* purposes. By attaching hose, they may be used for washing decks, which is a very expeditious method; for washing out sediment from the boiler; filling water casks, &c. They have proved efficient in several cases of fire on steam boats; and in one case, on the Sound, a boat (with some hundred persons on board) was saved from the dreadful fate of the steamer Lexington.

WATER BOATS.

I have supplied several water boats with pumps for forcing water on board ships, &c., and they have been found much superior to the single action pump heretofore used. One has been in service on the water boat at the Navy Yard, Brooklyn, for several years.

In connection with steam boat pumps, (as it may be useful to some readers) it may be remarked, that in September last I fitted up a 5 inch brass pump for Daniel Barnum, of this city, for the purpose of supplying a steam boiler, to be used on his plan of self acting safety apparatus. The success of his plan is fully shown by the annexed certificate, from which steam boat owners may understand the use of the invention, in addition to that of keeping up a certain and regular supply of water to the boiler.

I have examined Mr. Barnum's plan, and its operation; and the objections to plans of this kind that they are liable to derangement without the knowledge of the engineer, is done away with. The engines that work the pump are under the eye of the engineer, and their refusal to operate would show him that the valve in the boiler was out of order; and if the motion of the pump was too fast, that the pump valves were out of order. In either case, he would immediately be informed that something was wrong, and what, and where the difficulty was. I think an examination will satisfy any engineer, that Mr. Barnum's machinery is as little liable to derangement as any part of steam boat machinery, and that the advantages of its use are very great. His self acting safety apparatus was put on board the steamer Water Witch, under a special appropriation of Congress, after a favorable report of a committee of examiners to decide on the best plan among several that were presented.

CERTIFICATE.

" We, the undersigned, having witnessed the operation of Mr. Barnum's self acting safety apparatus on board the United States steamer Water Witch, while she was under public trial, do certify, that the apparatus, by its own action, supplied the boiler with great regularity, requiring no assistance from the engine; that its motion formed a most perfect index of the state of the water, (notwithstanding the boiler was said to foam continually during the trial,) stopping and starting of its own volition; its revolutions being in proportion to the amount of evaporation going on. In short, the whole operation was demonstrative of the entire success of the apparatus in affording a uniform supply of water to the boiler, so far as we are able to judge from the exhibition made on this trial.

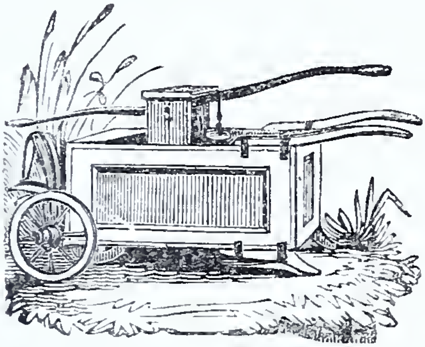
We also say that the apparatus was applied as a fire engine, as well as a bilge pump for pumping ship, for both of which objects, it possesses great power and efficiency. And we take pleasure, while bearing this testimony to the merits of Mr. Barnum's improvement, in expressing the opinion that he has done much to *prevent* or to *mitigate* the evils which necessarily result from *steam boiler explosions, fires at sea, and a sinking ship.*

CHAS. GANNETT, Commander.
J. E. BISPHAM, Lieut.
G. W. CHAPMAN, Lieut.
JOHN FARON, Jr., Chief Eng. U. S. N.
R. F. LOPER.
B. F. McMURTRIE.

Philadelphia, October 9, 1845.

GARDEN ENGINES.

The box of this engine will hold 40 gallons—with cast iron wheels, and handles so that one person can wheel it; 2½ inch double action pump, and will throw water 70 feet horizontally and 40 feet high, with one person to work it. They are well calculated for watering gardens, washing windows, destroying worms on trees or shrubbery, protecting buildings against fire from other buildings, &c. Sulphur put in water and thrown on plants, will destroy the worms on them. This engine would prove very useful to horticulturists, and may be made serviceable, in a drouth, for watering gardens, nurseries, &c.



STATIONARY FIRE ENGINES.

Stationary fire engines for cities and villages are, in many situations, superior to moveable engines. The pump may be placed in a well, and the pipe laid along the surface, and have one or more openings, with screws on the end, to fit the couplings on the hose used for fire purposes. To the pitman, attach a brake, with poles to work by any number of men required; the brakes to unship and be kept in a convenient situation, so as to be ready for working while the hose is being attached. An engine of this description may be set to work more readily than a moveable engine; and within reach of the hose, will prove more efficient than other kinds. For the purpose of supplying other engines, two or three leading hose may be attached to as many openings, as the power required to convey water through open leaders horizontally, is much less than that required to play from a nozzle. The same number of men playing through open leaders, will supply two or three engines playing perpendicularly from nozzles. The same pump may be used as an ordinary street pump, by having a brake fitted for that purpose, which may be detached when required.

The plan adopted in some places is to have a horse power attached, which being under ground, except the post to attach the horse lever, takes up but little room when not in use. The lever can be removed when not wanted. The public authorities offering a premium to those first supplying horses to work the pumps in case of a fire, would insure the pump in operation as soon as other engines could be ready to receive the water; and when the fire is near, they may play directly on it from as many leaders as the pipes are fitted to receive. The expense of engines on the above plan being much less than moveable ones, they are preferable when buildings are close and near a full supply of water. In many factory villages and other places having mills or water power of any kind near, with a large pump so placed as readily to be put in operation by a water wheel, with plenty of hose, it will constitute a fire engine of the most powerful and efficient kind. I have supplied pumps, hose, pipe, iron work, &c., for several U. S. arsenals and navy yards, to be used as ordinary pumps and fire engines; and in several instances they have been the means of saving large amounts of property.

STEAM ENGINES.

In some cases steam engines would prove profitable for raising water in premises where a large quantity could be used to advantage. A four horse power engine, with a governor and boiler all complete for use, can be furnished for $500. For the quantity of water one of this size will raise see table, (p. 28.) The amount of fuel it will consume would be, at the utmost, 10 lbs. per horse power per hour; for 10 hours, 400 lbs. anthracite coal, at $4 per ton, would be 71 cents per day of 10 hours; and the engine is capable of raising 20,000 gallons of water 100 feet perpendicular in that time. If a reservoir, capable of holding that quantity, would give a full supply for a week, the engine would require running only 10 hours in that time. It might be used for other purposes that would, with the object of raising water, render it advantageous. Other fuel might be used, in many instances, at much less expense. Engines of the above description are very simple in their arrangement, and the management of them is easily acquired. The uses to which they may be applied on a large farm or plantation are numerous, such as grinding coarse fodder, cutting corn stalks or hay, straw, churning, grinding apples, steaming food for cattle, turning a grind stone or lathe, boring fence-post holes, sharpening rails, sawing wood, &c. &c.

Prices of Steam Engines.—The prices given below are those of *one* of the best manufacturers in the United States—William Burden, 100 and 102 Front Street, Brooklyn, L. I. They combine all the latest improvements, and are finished in superior style of workmanship, doing credit to the manufacturer. The prices include flue boilers, with governor, pump, cut-off, &c., complete except masonry:

Horse Power.	Price.
4	$500
5	600
6	700
8	900
10	1,100
12	1,300
15	1,600
20	2,100
25	2,500
30	$3,000
35	3,300
40	3,550
50	4,000
60	4,500
70	5,000
80	5,300
90	5,600
100	6,000

STATIONARY STEAM ENGINES.

The advantages of raising water into a reservoir for supplying boilers is very considerable over the plan of drawing water direct from wells or streams, and supplying the boilers with cold water. When the supply is taken from a reservoir, the exhaust steam may be used to keep up heat in the reservoir, supplying the boilers with warm instead of cold water, making a great saving in fuel, and keeping up a better head of steam. I have furnished many pumps for raising water to the reservoir, which have given full satisfaction. The power necessary to work them being, in most cases, so small, no sensible check was occasioned to the engine.

RAILROADS.

For water stations on railroads I have supplied pumps in almost every variety of situations. The Reading Railroad has a 4 inch pump at Richmond worked by steam; at Norristown water station a 6 inch pump, worked by a water wheel, taking the water from a spring and raising it to a reservoir 400 feet distant; a 5 inch pump at Port Kennedy station, worked by a water wheel, 350 feet of pipe, 40 feet rise to the reservoir, and gives 32,000 gallons per day; a 4 inch pump at Pottstown station, worked by a horse; a 6 inch pump at Schuylkill Haven, forcing water 2,200 feet, 40 feet rise, worked by a water wheel. Other railroads are supplied with them, and several working in deep wells, raising water, in some cases, over 90 feet.

IRRIGATION OF LAND.

The value of water to irrigate land is not generally appreciated in this country. In most cases the increased crops from the use of the surplus water would pay a large per centage on the amount of outlay for water works. If farmers who have not water convenient would keep an account of time expended in bringing water for family uses, particularly washing days, as well as that of driving their stock to water, they would generally find water works would prove a matter of economy as well as of convenience. Cattle, horses, hogs, and in fact *every* living creature, thrive materially better when having at all times a plentiful supply of pure water. Many farmers have milk houses at springs a considerable distance from their dwellings, when for a small outlay they could have the water from the same spring running through a milk house at their door, and could do their weekly washing in their houses instead of at the spring. There is much improvement in the taste of farmers generally in this country, respecting the style and convenience of their dwellings and out buildings and the cultivation of their lands; and as plenty of good water is necessary to render premises *comfortable*, that object becomes one of first importance to those not favored with that luxury. When persons are disposed to beautify their premises, having plenty of water at sufficient height, they may make many uses of it to promote health and enjoyment—first, baths for immersion and shower bathing, (the latter of which I can from personal experience highly recommend, having adopted it about 18 months since, taking one every morning *immediately* after leaving bed, and so far as my health, strength, and feelings are concerned I think my age renewed at least 10 years,) fountains, cascades, running water, fish ponds, with gold fish sporting, and others with pickerel, which may be fed for the table, as well as pigs.

Should you have ideas of the beautiful sufficiently strong to induce you to make a fish pond, don't forget to put in a few islands, more or less, and if you have a fountain or jet on one of them, which we will suppose about 8 feet diameter, throwing up a number of fine streams circling outward and falling in a circle around the island—it will not injure the appearance. On one of the larger islands please put an arbor with sufficient room and seats for two lovers at least. Around this may be various flowers and vines, sufficient to keep persons within from being seen but not to prevent their seeing the surrounding beauties; and in order to enable them to get ashore when so disposed a tasteful rustic bridge must extend from this romantic island to the *main land!* This and much more is easily accomplished, and in fact every part of a country residence or farm grounds may be made to teem with beauty if a person have the taste and will to improve upon nature. As this subject does not properly *belong* to this work, I have only taken the liberty to hint, and hope that is sufficient for the wise.

CITIES, TOWNS AND VILLAGES.

Cities, towns and villages may, with few exceptions, have a full supply of soft wholesome water for every family. The expense, when divided among many, is light, and as pure water is conducive to health, all (except physicians) are interested in having it in plentiful supply. It is seldom that the inhabitants of cities or towns will vote to tax themselves to raise the necessary funds to build water works, but they are generally willing to grant the necessary privileges to one or more individuals, who will undertake the business ; and, as far as my knowledge extends, such individuals or companies have made the undertaking profitable, at the same time the citizens are benefited by having plenty of good water at a cheap rate. Some towns or villages may be supplied with water by springs or streams, from sufficient elevation to discharge water at any required height, but when that is not the case and a water power cannot be had rightly located to answer the purpose, the next best power is steam ; and as an engine requires an engineer and fuel, the engine might be made to pay expenses by renting out power to propel machinery, reserving sufficient to raise the requisite quantity of water. When no high ground is conveniently situated for reservoirs, they may be placed on top of the building that contains the engine and pumps, as has been often done, viz. Burlington, N. J. and the same plan is being adopted at Camden, N. J.

In one case within my knowledge where a few individuals had a grant from the citizens of a town of about 4000 inhabitants, for supplying water, the subscriptions obtained in one day at the regular charges, amounted to 5 per cent. on the whole outlay, $25,000. And the income from renting the power of the engine, with rent of building, would pay all the expenses incident to the business, and leave a surplus. In all probability the stock will pay in two or three years 10 or 15 per cent., and continue to increase with the population. I think water works judiciously located, will prove the best permanent investment to be found. I have been in places where the yearly average expense of hauling by horses, &c. would pay more than 7 per cent on the cost of furnishing water to every family at their own doors.

Another *important* consideration is having a plentiful supply of water in case of fire. This is not *generally* appreciated until property has been destroyed sufficient in some cases to build a dozen water works. It is quite a matter of economy to supply a place with plenty of water to extinguish fires *before* a great fire, in preference to doing so *afterwards.*

To enable persons to estimate the cost of water works the present prices are given below of cast iron pipe, in small quantities. When large quantities are wanted some discount can be had. Owing to the unprecedented rise in the price of iron for a year past, pipe has advanced very much—for instance, 4 and 6 inch pipe are 20 cents a foot more than they were one year since. From the increase of iron works, it is presumed that the prices here named may be reduced before long. I think iron will not be *higher* in any event. I would observe that lead pipe is generally preferable for any size under 1½ inches.

1	inch	cast	iron	pipe	16	cents	per	foot.
1¼	"	"	"	"	18	"	"	"
1½	"	"	"	"	22	"	"	"
2	"	"	"	"	30	"	"	"
2½	"	"	"	"	33	"	"	"
3	"	"	"	"	38	"	"	"
4	"	"	"	"	60	"	"	"
6	"	"	"	"	80	"	"	"
8	"	"	"	"	1.25	"	"	"
10	"	"	"	"	1.50	"	"	"
12	"	"	"	"	1.75	"	"	"

Elbows, branches, angles, &c. 3½ cts. per lb. for 3 inch and over.

The patent improved lead pipe, manufactured by Tatham and Brothers, office 15 Minor-street, Philadelphia, and No. 249 Water-street, New-York, is remarkable for accuracy of calibre and uniformity of thickness; for the perfect polish of the interior surface; the absence of *scales* and *flaws;* for solidity and unusual strength—and the following long lengths, by avoiding the expense of numerous jointings, offer decided advantages to water companies, and in contract work. Their pipes and tubes are made by a newly invented process, to which the manufacturers hold the patent right, and are of a better quality than can be produced by any other method.

WATER PIPES FOR HYDRANTS, PUMPS, &C.

Calibre.	Weight per yard.	Average lengths.
⅜ inch light	2 lbs. 9 oz.	80 feet.
“ medium	3 “ 3 “	70 “
½ “ light	3 “	75 “
“ medium	4 “	60 “
“ strong	5 “	70 “
“ extra strong	6 “ 6 “	55 “
⅝ “ light	5 “	65 “
“ medium	6 “ 8 “	60 “
“ strong	7 “ 6 “	50 “
“ extra strong	8 “ 4 “	45 “
¾ “ extra light	5 “	60 “
“ light	6 “ 4 “	47 “
“ medium	8 “	43 “
“ strong	9 “ 12 “	35 “
“ extra strong	10 “ 8 “	33 “
1 “ extra light	6 “ 14 “	60 “
“ light	8 “ 5 “	45 “
“ medium	10 “ 4 “	35 “
“ strong	12 “ 4 “	30 “
1¼ “ extra light	8 “ 2 “	45 “
“ light	9 “ 12 “	38 “
“ medium	11 “	32 “
“ strong	12 “ 8 “	25 “
“ extra strong	14 “ 10 “	21 “
1½ “ extra light	10 “ 8 “	45 “
“ light	13 “	30 “
“ medium	15 “ 8 “	25 “
“ strong	19 “	20 “
1¾ “ extra light	11 “	30 “
“ light	13 “ 6 “	25 “
“ medium	16 “	24 “
“ strong	20 “	18 “
2 “ light	16 “ 12 “	24 “
“ medium	20 “ 8 “	16 “
“ strong	23 “	14 “

FOUNTAIN OR AQUEDUCT PIPE.—*No.* 1, *Stronger Size.*

Calibre.	Length.	lbs. per yd.	Calibre.	Length.	lbs. per yd.
⅜ inch	60 yds	1½	¾ inch	25 yds.	3½
½ “	40 “	2	1 “	35 feet	5¾
⅝ “	30 “	2½	1¼ “	60 “	7

GENERAL OBSERVATIONS.

The foregoing pages, giving the purposes for which the pumps I manufacture are used, and in some cases details of the plans of operation, do not comprise all nor in fact but a small part of the various situations and purposes for which I have supplied hydraulic apparatus. The circumstances are so varied in the different situations, that it would increase the bulk of this work too much to enter into particulars to meet the requirements of every one, but this much I should say, that any building or place, however situated, provided there be a source from which to draw a supply, can by some of the plans named in this work, have water conveyed to any part of the premises in quantity limited only by the supply. I have intended to give a sufficient variety in detail to enable those persons desiring information to form an opinion from the different plans which would be best for them to adopt—I have likewise given the prices of iron and lead pipe, pumps, &c. and such tables as I thought might be useful in enabling readers to estimate somewhere near the cost of putting up water works. When required I shall be happy to give any information in my power, or make plans, drawings, estimates, or contract for the supply of materials for water works of any kind.

Table showing the different sizes of Pumps and the Quantity of Water each is capable of raising at 30 double strokes or revolutions of the crank, and the price of each size, fitted up on Iron Frames, with Guides, Shackles and Air Barrels complete, to work by Power.

Diameter of pump chamber.	Length of stroke.	Quantity of water raised in 30 revol'ns.	Price of Pump.	Position of Pump.
2½ inches.	6 inches.	7½ galls.	$35	Perpendicular.
3 “	8 “	14½ “	45	“
4 “	8 “	26 “	55	“
5 “	8 “	41 “	65	“
6 “	12 “	88 “	125	“
6 “	24 “	176 “	200	“
6 “	30 “	220 “	225	Horizontal.
6 “	36 “	264 “	250	Perpendicular.
6 “	60 “	440 “	300	“
7 “	8 “	80 “	125	“
11 “	9 “	222 “	225	“
11 “	24 “	592 “	325	“
12 “	24 “	704 “	350	Horizontal.

These prices are for iron pumps, which are best calculated for fresh water. When pumps are wanted for salt water, for acids, alkalis, &c. brass pumps are used, for which an additional price, equal to the difference between iron and brass, is charged.

AREAS OF CIRCLES.

(Useful for finding the contents of Pump Cylinders.)

Diameter. Inches.	Area. Square Inches.	Diameter. Inches.	Area. Square Inches.	Diameter. Inches.	Area. Square Inches.
1	.785	5½	23.758	13	132.73
¼	1.227	¾	25.967	14	153.93
½	1.767	6	28.274	15	176.71
¾	2.405	¼	30.679	16	201.06
2	3.141	½	33.183	17	226.98
¼	3.976	¾	35.784	18	254.46
½	4.908	7	38.484	19	283.52
¾	5.939	¼	41.282	20	314.16
3	7.068	½	44.178	21	346.36
¼	8.295	¾	47.173	22	380.13
½	9.621	8	50.265	23	415.47
¾	11.044	¼	53.456	24	452.39
4	12.566	½	56.745	25	490.87
¼	14.186	¾	60.132	26	530.93
½	15.904	9	63.617	27	572.35
¾	17.720	10	78.540	28	615.75
5	19.635	11	95.033	29	660.52
¼	21.647	12	11.309	30	760.86

INSTRUCTIONS TO THOSE PUTTING UP PUMPS.

The first important act is to examine and try your pump, and see that it is in perfect order. Trust not to the manufacturer, but be sure you *know* that the valves set fair and the piston leathers are not too tight; the piston ought, in all cases after the packing is well soaked, to play freely and easily. If the piston will not drop down of its own weight when the neck packing is loose, then take it out, and with a sharp knife shave it carefully until it play easily. The piston will draw water as well when going free as when tight, and will draw as well when the leather is worn as thin as paper. Try your pump by putting in water, and, with one hand covering the opening, work it with the other.

For 2½ inch pumps I have found 1 inch pipe, weighing 6 lbs. and 14 oz. per yard, to be of sufficient weight. The pipe ought to be carefully handled, and not laid with dents and bruises. One way of taking out bruises is to procure a brass ball, of nearly one inch diameter, and, through a hole drilled in it, run a strong cord; the ball should be rubbed with tallow and inserted in the pipe, and you will then be enabled to draw it through by the cord, which will take out the bruises. In some cases, if the bruise is bad, it is better to saw off the pipe and make a joint. In laying lead pipe, recollect particularly not to make any *short* turns; all crooks in pipe cause friction, and the longer the turn the better. I think a right angle, by putting pipe together with a mitre joint, will be a loss of 15 per cent. if the pump be worked fast.

When pipe passes down a well or along a wall, have it well supported at short distances—the motion of the water passing through pipe would cause it to settle if not well supported.

Respecting soldering the joints:—Let your solder be fine tinman's solder; by having a ladle with a small spout, you can melt it and run it into strips about as large as a pipe stem and from 12 to 18 inches long. Your solder irons, (as commonly called, although made of copper,) should be what is termed hatchet shape—the head about 1 or 1¼ inch thick and 2 inches wide, the handle, of iron, inserted in the thinnest side near the top, the lower part drawn to an edge the longest way. This is the best shape for soldering lead pipe, with cup joints.

To prepare the pipe for soldering, have a hard wood plug, about 5 inches long, turned round, say 1½ inches diameter, one end of the plug to be turned down for about one inch in length to one inch diameter, then rounded out boldly to its greatest diameter. This plug is to open the end of the pipe by driving in the small end of the plug until the end of the pipe is cupped out sufficiently to receive the end of the one you wish to connect; scrape with a knife the parts to be soldered; clean and sprinkle pounded rosin in the cup, and you can readily make a strong joint with a very small quantity of solder.

When selecting a place in a dwelling for a pump, two circumstances must be taken into consideration; first, security against frost; second, to get the pump as near (perpendicularly) to the water as you can, bearing in mind not to place it more than 25 feet above the water—horizontal distance makes very little difference. The pump must be firmly secured in its place, and be so situated that the valve boxes may be easily got at. When a pump is to be placed in the basement of a building and the brake in the story above, by fastening the brake first in the position it is meant to be used, and, with a line plumbing down, the true position of the pump may be ascertained. When the pump is to be placed immediately below the brake, it ought to be put on an iron frame, with a guide and pitman, to prevent the vibration wearing the stuffing box or bending the piston rod. When the distance from the brake to the pump is 7 feet or more, a wooden pitman is best. I have used spruce for that purpose, 63 feet long.

The utmost care must be taken that there be no leak in the pipe below the pump—in fact, this is the most important point in putting up pumps, and you should be *sure* your work is well done before covering up the pipe. If there be a leak below the pump, bubbles of air will come out with the water, which may be seen by looking through the stream as it leaves the spout. Sometimes, owing to a leak, the pump will not deliver water with the up stroke, in consequence of air being drawn in with the water and rising and remaining in the top of the pump. When pumps are placed in houses, and the pipe leads a considerable distance, it is well to put a valve on the lower end of the pipe, (see remarks on page 12.)

IRON PIPE.

The manner of connecting iron pipe is as follows: After the ditch is prepared the pipe is laid in, and one end inserted in the bell of the next length. Each length to be laid on a brick, stone or piece of wood to raise it a few inches from the ground. When the pipe is properly placed, packing of oakum or a slack twisted cord or small rope cut the proper length to go round the small end of the pipe, is crowded into the opening between the pipe and cup at the joint—then have some blue clay and after slightly wetting, work it in the hand until it adheres well together, and form it into a roll about 1¼ in. diameter, of sufficient length to go round the pipe at the connection, forming with the fingers a cup on the upper side, into which molten lead is poured; then take off the clay, and with a cold chisel cut off the sprue or gate and set in the lead with a square end iron tool—this is the usual method of putting together cast iron water pipes and easily performed by any man of common ingenuity—a little practice will make an expert workman. A beginner should try the pipe before covering up, and if it leak the joint can be set over again. The pipes may be put together in pairs before laying in the ditch, which expedites the work.

In placing a pump in any other than a perpendicular position the upper valves ought to be hinged in front same as the lower ones, and the air vessel so made as to stand perpendicular, by having a bend immediately above the flanch. When pumps are put up in wells, you will find it advantageous to place them as near the water as you can and have room to get at the valves.

Any further instructions are deemed unnecessary, as the business is not intricate, and all that is required beyond what has been given will readily suggest itself to any person undertaking the business. It may be well to say that a job had better not be undertaken unless the person wanting the work is willing to pay for having it *well done*, hydraulic apparatus being among the worst kinds of work to slight, as there is more labor in righting a bad job than to do it well in the first place. Pumps should be put up with as much accuracy as a steam engine or any other machinery. Under any and every circumstance do not leave a job until it work to perfection; then it will do you credit and increase your business.

AIR PUMPS.

I have manufactured several air pumps on a different plan from any I had previously seen in use. They were made with a single two inch cylinder, 12 inch stroke, double action, with pipes so connected that the pump would form a vacuum or condense, at pleasure. They were placed on a frame with a long brake, giving great power to the operator. These pumps have proved far superior to those in general use. When an air pump is required to be of the most perfect kind and of superior power, one for purposes that only a superior machine will answer, you can call on me. I insert the result of Mr. Meacham's experience in the use of one for supplying air to a person under water with a sub-marine armor:

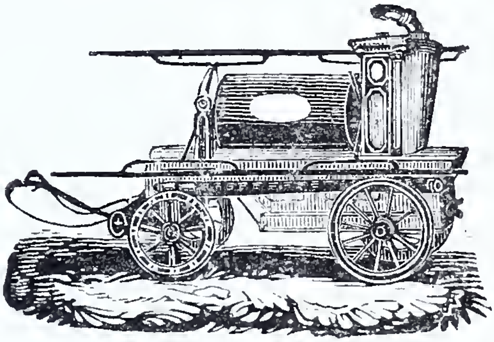
> "Having had occasion to use air pumps in various operations, I called upon Mr. Farnam and procured one of his construction. I have fully tested its value by forcing air under water over 50 feet, and find it a very superior article. The labor required to operate it is not one fourth that necessary to work others I had previously made use of. It is not liable to get out of order, and is a most perfect piece of machinery. R. MEACHAM.
>
> *New-York, June* 4, 1839."

FIRE ENGINES.

Most of the fire engines in the United States are built with two single action cylinders or pumps, open at the top, with a valve at the bottom of each cylinder, and two valves under the air barrel, working by levers either at the side or end.

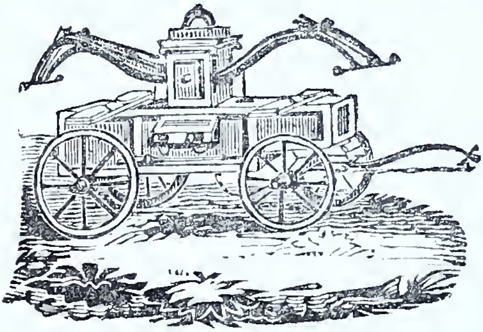
SIDE ENGINE.

The following cut represents an engine working on the sides, the cylinders placed across the box or cistern, and the air vessel behind the cylinders. Side engines, from their peculiar construction, are obliged to have short levers, and require a quick stroke to be efficient. From the short distance the poles are from the centre, they work on a circle so small, that the vibration, from a perpendicular, necessarily gives the body of persons working the engine a motion in and out, which is a serious objection; which, with the necessity for rapid motion, will tire out men in a short time; and he is a good fireman who can stand it three minutes. Thomas Ewbank, in speaking of the objections above named, in his work on Hydraulics, (page 337,) says, "this is sufficient to induce efforts to supersede the present mode of working pumps of fire engines, and particularly so, as the labor is so severe that few can continue it above a minute or two at a time, when, if relays of men are not ready, buildings on fire are left to their fate. The jar or concussion produced by the violent contact of the levers with the sides of the carriage at every stroke, is a source of waste of firemen's energies, and want of uniformity in their movements when at work is another." When a short lever side engine is played, the water passing through open leaders, the motion, when full worked, is so quick that if a person take a stick in his hands, weighing 5 or 6 pounds, and make the same number of motions in as quick time as made while working the engine, he will become tired out in a few minutes. The power applied to work the engine is dependent on the



muscles of the arms ; but the whole body has to be in violent motion, owing to the poles moving in so small a circle.

LONG LEVER ENGINE.



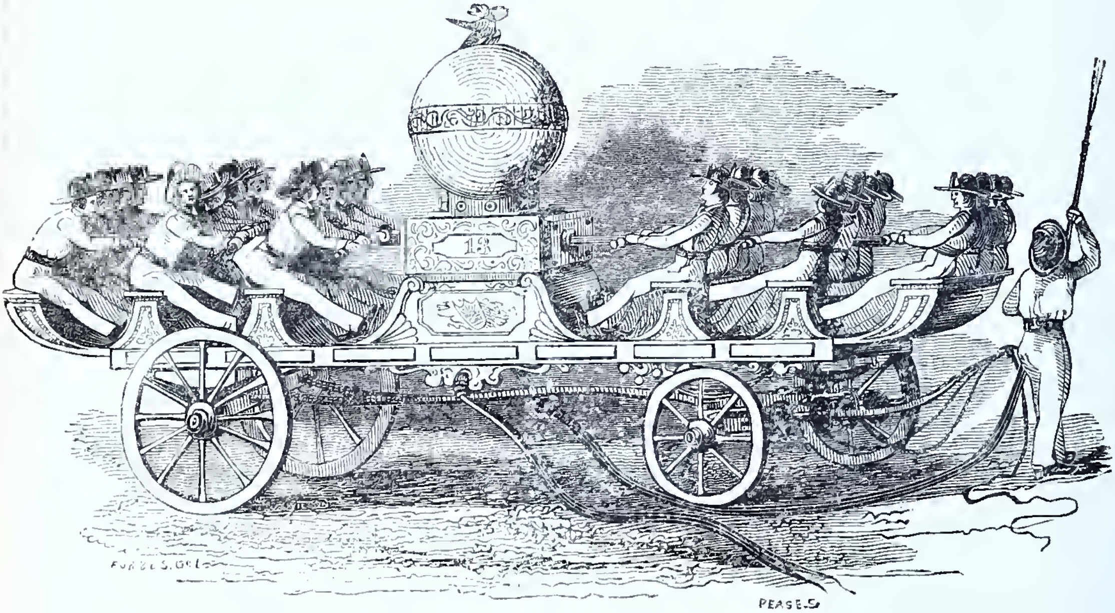
This cut represents a fire engine working across the ends, the cylinders fore and aft, and the air barrel between them. Engines on this plan have direct connection of the piston to the cross bars of the brakes, doing away with the chains and wheels, as on the side engines, and with them much machinery, useless weight and friction. The levers are long, and consequently the poles have a more perpendicular motion. The cylinders or pumps are large, which render them efficient with a slow motion, and enable firemen to apply the weight of their bodies to assist in working the engine ; and one set of firemen will work an engine (on this plan) for hours without changing, which is one among the many advantages that the latter has over the side engines. In all cases where the two kinds of engines have been brought to work side by side at a fire, the advantage of the engine working across the ends, over those working on the side, is so evident that preference will be always given by those acquainted with both kinds to the long levers. From a full knowledge of their superiority, I have built, with few exceptions, all my engines on the latter plan ; and with the gain over the two cylinders in using the pumps I manufacture, they have been found to possess decided advantages. One cylinder only is used, which, being double action and throwing water equally the up and down stroke, has less than half the friction of the engine with two cylinders. The reason why I place the friction at less than half is, first, there is but one piston to do as much as two of the other kind ; and, secondly, in consequence of the cylinder being closed at the top, and water both sides of the piston, it is unnecessary to have the piston tight. The open top pumps must have the piston air tight, or they will not draw with a suction; while, with my pump, the piston may, and ought to be, so free as to drop down of its own weight. When the piston is put in motion, the expansion of the leathers on the piston makes a perfect joint without any more friction than is necessary to effect that purpose. Another great advantage is the ease of getting at the valves, as they are all below the air barrel, and the removal of four screws enables them to be taken off; also the less weight of the double action pump, compared with the two cylinders of the same capacity. Engines with my pump need not weigh over one half to be equally powerful and as permanent as one of the side engines. I had a trial of an engine of my build with a large side engine; mine had 24 men, the other 40; and the result was that each threw a 1¼ inch stream 105 feet high —mine with 24 equalling the side engine with 40 men.

As one of the objects of this work is to give my views of the best hydraulic apparatus, I will here introduce a

NEW PLAN OF WORKING FIRE ENGINES.

(*See Engraving on next page.*)

From experiments we have reason to believe, this will supersede the old plans of working. Mr. Ewbank, in his work on Hydraulic Machines, says that "when a man's strength is applied as in the act of rowing, the effect is nearly one hundred and fifty per cent. more than in moving a pump lever. This is sufficient to induce efforts to supersede the present mode of working the pumps of fire engines." It will be perceived by the drawing, that the firemen sit with one or both feet braced up nearly level with the seat; and it has been found that a man of no more than ordinary strength will, in this position, raise a weight of 150 lbs. thirty inches, and keep the weight passing up and down that distance as many times a minute as the usual number of strokes of an engine. It is known that firemen, working on side engines, do not apply over 30 lbs. on an average; and on an engine with long levers working across the ends, about 50 lbs. In addition, it must be understood, that a man raising 150 lbs. as above named, can continue to do so much longer than a fireman can work on the ordinary fire engine, while the labor will not be as fatiguing.



I think ten men working an engine on this plan will do as much execution as twenty on a side engine. There are other advantages that will operate to bring them into general use as fast as new engines are required, and the superiority of these become known:

1. The weight of an engine of equal capacity is not over half that of the old kind; and being on springs, the machinery will last much longer, and may be run with a much less number of firemen, which is of importance, particularly in the country.

2. Another important consideration is, that they can be manufactured and sold at a much less price than the old kind.

3. When economy is studied, the pump, suctions, hose, &c., will be furnished, with such drawings as will enable purchasers to have the balance of the engine made in their own places, which is sometimes a great advantage.

It will be observed in the engraving that the water is taken in and the jet issues from below, consequently the firemen are not exposed to be wet from above nor below. When a cistern is required, it can be attached below the frame.

Farther particulars of the comparative results, the prices of the different sizes, price of engine without running gear, &c., will be given on application by letter or otherwise.

D. L. FARNAM, 29 FULTON STREET, NEW YORK.

LIST OF PRICES.

Garden Engines, throw	20 gals. per minute,	2½ inch	pumps,			$40 00
Plantation Fire Engines,	66 gals.	"	4	"	"	125 00
" " "	100 "	"	5	"	"	175 00

The above Plantation or Factory Fire Engines have iron wheels, are compact, easily handled, and complete in every respect, except Suction Hose, which can be added for - - - - - - - - - 50 00

CITY AND VILLAGE FIRE ENGINES, (DOUBLE ACTION PUMPS.)

	4	Inch Pump,	to	throw	66	gals. per minute,	with	8	men,	$200 00
	5	"	"	"	120	"	"	" 12	"	300 00
Two	5	"	"(on one bed see page 11)"		240	"	"	" 18	"	500 00
	6	"	"	"	200	"	"	" 16	"	450 00
	7	"	"	"	250	"	"	" 20	"	600 00
	11	"	"	"	360	"	"	" 40	"	1000 00

The above are finished in first rate style, wheels large, and as light as consistent with strength.

LIFT AND FORCE PUMPS, (DOUBLE ACTION.)

2½ inch House Pumps, complete, (except air barrel and pipe,) raise from 12 to 20 gallons per minute, - - - - $25 00

3 inch	Pump,	raises	30	gallons	per minute,	(With air vessels, coupling screws, &c.)	42 50
4 "	"	"	50	"	"	" " -	50 00
5 "	"	"	80	"	"	" " -	60 00
6 "	"	"	150	"	"	" " -	100 00
11 "	"	"	400	"	"	" " -	200 00

Lift Pump, Air Barrel and Pump Head for 3 inch iron pipe, for wells from 80 to 175 feet,	$60 00
Iron Lift Pumps, for Cisterns, single rods, $5; double rods,	5 50
Horse Powers, for small Pumps, complete for 1 horse,	75 00
" " for large " for one horse, $100; for two horses,	150 00

WIND MILLS AND WATER WHEELS.

Wind Mills complete, with or without lower frame, from $75 to	250 00
Over Shot and Breast Water Wheels, to work pumps, from 3 to 9 feet diameter, iron shaft, crank, flanches, and boxes, (or iron work alone,) from $50 to	100 00
Cast Iron Slide Valves, 4¼ inch opening,	15 00
Air Pumps, Double Action, 12 inch stroke, (superior article,)	100 00

HOSE.

Superior Leather Leader Hose, made with best Wrought Copper Rivets:

1	inch	diameter,	4	inch	leather, per foot,	$0 30
1¼	"	"	5	"	"	0 37½
1½	"	"	6	"	"	0 50
1¾	"	"	7	"	"	0 56
2	"	"	7½	"	"	0 60
2¼	"	"	8	"	"	0 65
2½	"	"	9	"	"	0 70
2¾	"	"	10	"	"	0 75

Large Hose, Molasses, Locomotive, Sewed, and Suction Hose made to order.

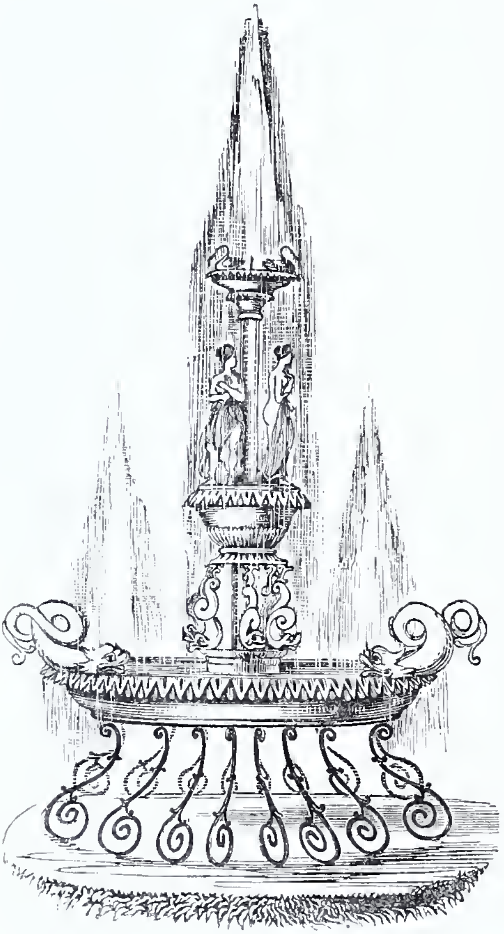
Suction Hose,	per foot, from $2 to	5 00
Molasses do	" " 50 cents to	1 00
Locomotive	" same price as Leading Hose.	
Sewed, 3 seams	" " " " "	

☞ Conch Shells for ornamenting Fountains, $4 per hundred.

FOUNTAINS.

In 1841 the author of this work commenced the manufacturing of cast iron ornamental Fountains, and the cut below represents one of the first pattern he finished; one of which was placed in the Horticultural Room at the Fair of the American Institute, and the Examining Committee awarded a Gold Medal. The following is an extract from their report:

This superb article might truly be said to form the climax of garden ornaments. It was got up by Mr. D. L. Farnam, of New-York, in a style that would do honor to any country, and displaying a taste and skill which richly entitle him to patronage.—It consists of an extensive and lovely basin of clear water, in which gold fish are sporting over a bottom embedded with shells and aquatic plants, and surrounded by four Tritons sitting on the edge, and each throwing up a jet of water like a burnished silver wire, to the height of six or seven feet, and meeting another jet from the centre, the whole falls into a little basin which forms the cap of a highly ornamented column of three or four feet high, from which it trickles over the edge, falling down on three female figures of great



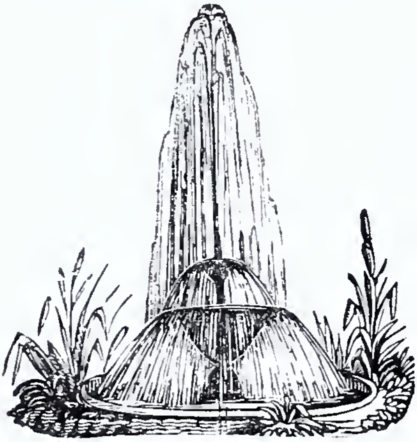
beauty, which surround the column, and thence returned to the fountain. A few tasteful gardens scattered about the country, each exhibiting such a fountain would do much towards awakening a better taste in rural matters. Where there is a small stream of water near a garden level, the cost of such a fountain will be trifling, and even where the water must be supplied by artificial power, there are abundant ways and means to facilitate the procuring a cheap supply.

Yours, respectfully,
ALEXANDER WALSH,
LUTHER TUCKER,
W. EMERSON,
J. B. NOTT.

I have had several applications, by letter, for information on the subject of the best plan of making a *cheap* fountain, and will here describe one.

First, we will take it for granted that there is a head of water 8 feet or over, that will supply 25 gallons or upwards per hour: select a location, say the centre of the grass plot, or gravel walk in front of your house; then drive a stake for the centre, and with a rope and stick sweep a circle of the size you wish the basin—take out the ground from the centre outward, forming a basin sunk in the centre 10 or 12 inches. The earth taken from the basin I should remove, as I think a raised bank around a fountain does not improve it. By cutting your circle clear through the turf you will have a handsome grass edge around the basin. The pipe from the reservoir may be half inch, and will cost about 87½ cents a rod. This pipe must be brought in a trench to the foundation and rise perpendicular in the centre. To this end you want a brass rose jet that will cost say one dollar. To carry off the superfluous water you can insert a pipe at the height you want the water to stand in the basin, and lead the water off under ground, or let it run off on the surface, which will do no injury as to appearance or in fact, as it will be pure water. The next operation is to make the basin tight, which on the *very cheap* plan may be done with clay, by puddling the bottom and sides, or by a coat of hydraulic cement which will be but a small expense. In using cement, mix one-third clear sand with it, and plaster the inside of the basin, having first rammed the ground hard. Next get, if you can, clean white pebbles of the size of a walnut or thereabouts, to cover the inside of the basin, and surround the pipe with handsome clean stones piled in the shape of a cone. This being done, you will have a fountain something like that represented in the engraving below, only much handsomer.

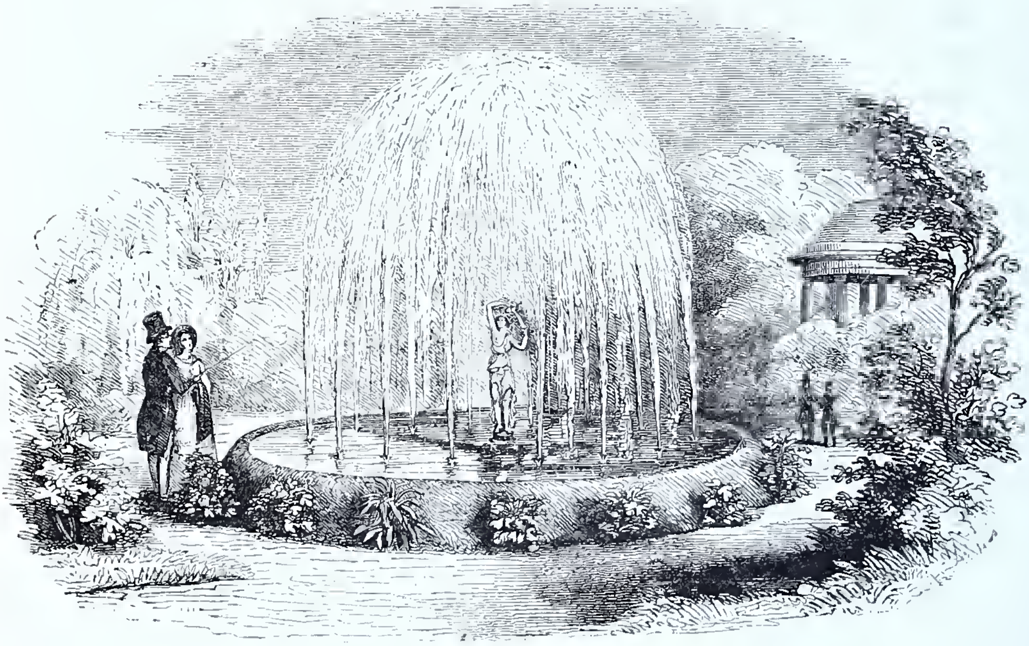
Running water in the form of a jet or cascade, or in *motion* any way, gives animation to the scenery, renders the air pleasanter in warm weather, gives life to vegetation in its vicinity, and pleasure to all within the sphere of its attraction. Those who have a supply of water must be wanting in energy, taste or information, or they would have fountains, when the whole outlay besides their own time, will be for the lead pipe, as they may dispense with brass work, and contracting the lead pipe at the end, have a single stream rising perpendicularly, which will spread at the top, and by some is admired more than the rose jet. There, reader, you have a plan of a *cheap* fountain that can be made in a day, and as there is no objection on account of expense, if you have the water, go to work and improve your advantages. After you have found the increase of enjoyment to yourself, family and visitors, perhaps in gratitude you will feel disposed to increase the pleasure of sight by sending to me for something to *ornament* your fountain.



No. 1, price $10.—A lily and cap with brass rose jet (or any other that may be preferred) 16 inches high and 15 inches diameter at the top, of cast iron, composed of a circle of leaves and cap. This being placed on the top of the stones as stated in the description of cheap fountain, would enhance the beauty of it very much.

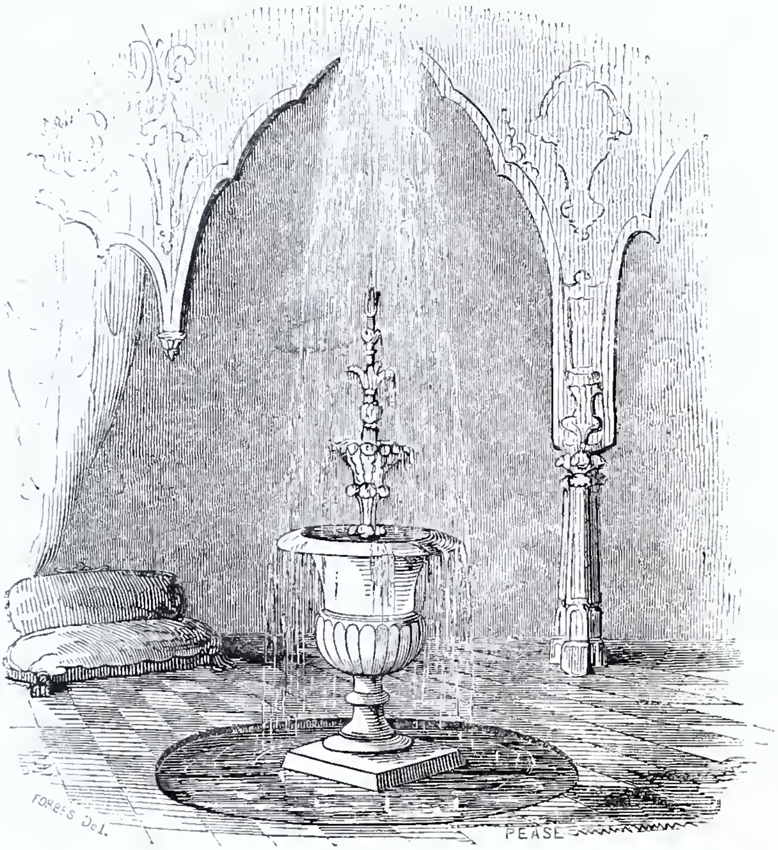
No. 2, $12.—An urn, as may be seen in No. 5. The price includes only the urn, pipe and jet. The height is 2½ feet, diameter across the top, 2 feet. It is a fine ornament for grounds even without water.

No. 3, $15—A swan. Not having a separate cut I refer to cut No. 6, where the swan is represented above the pan, the height 2 feet 5 inches, spread of the wings 26 inches, a pipe passing through the body and neck with jet to screw on in the open mouth. The pipe has only to be connected with the supply pipe and the swan is ready to play.



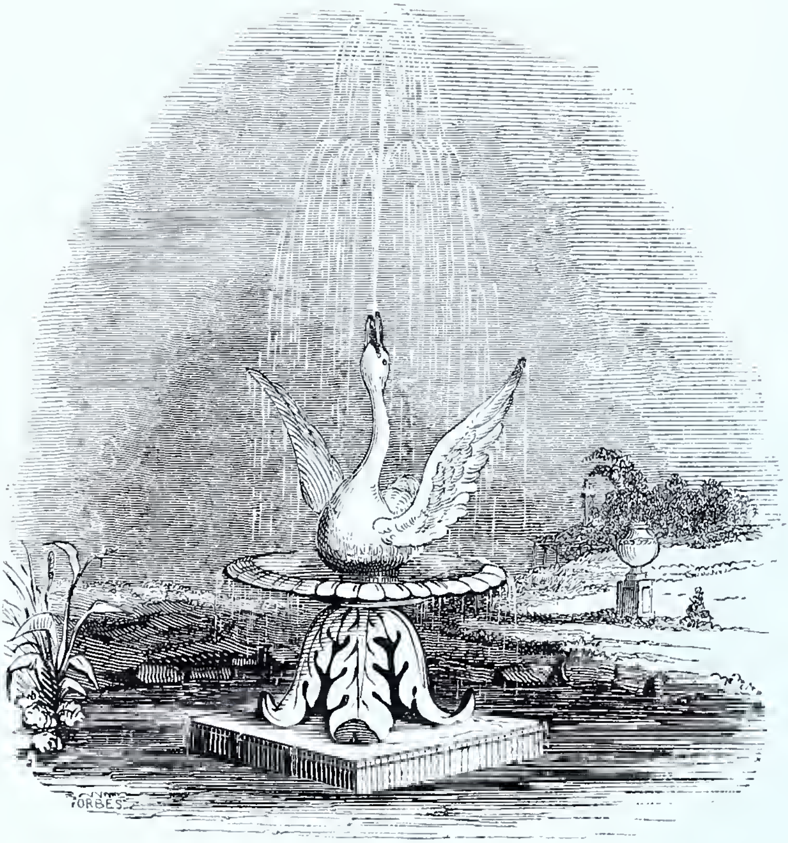
No. 4, $25.

No. 4.—Figure of Hebe. Height three feet three inches.—She is represented standing, and pouring from a pitcher in her right hand the bright, sparkling emblem of health into a bowl in her left. This figure surrounded by a number of fine streams of water and enveloped in watery spray, presents a chaste and classic aspect. The jets for the surrounding streams go with the figure, and are to be attached to a circular pipe, the jets being just even with the surface of water in the basin. If the basin be lined with white pebbles and surrounded by conch shells, the appearance will be much improved.



No. 5, $35.

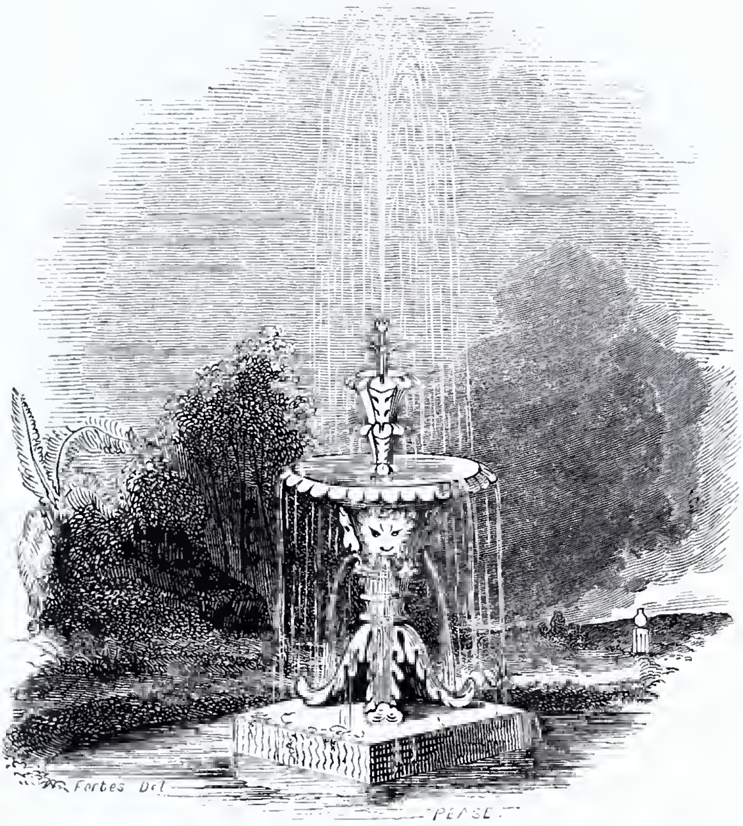
No. 5. Urn, lily, post and other ornaments, making the whole about 5 feet high, the base 14 inches square, with the pipes, jets, &c., complete and ready to unite with the supply pipe. The water from the centre jet falls back on the ornaments, dripping from one to the other into the urn, then running over the edge into the basin below. This forms a beautiful ornament. The urn may be placed on a rock or large stones, in the centre of the basin. I have put them up in this way in a basin of 16 feet diameter, producing a beautiful effect.



No. 6. $40.

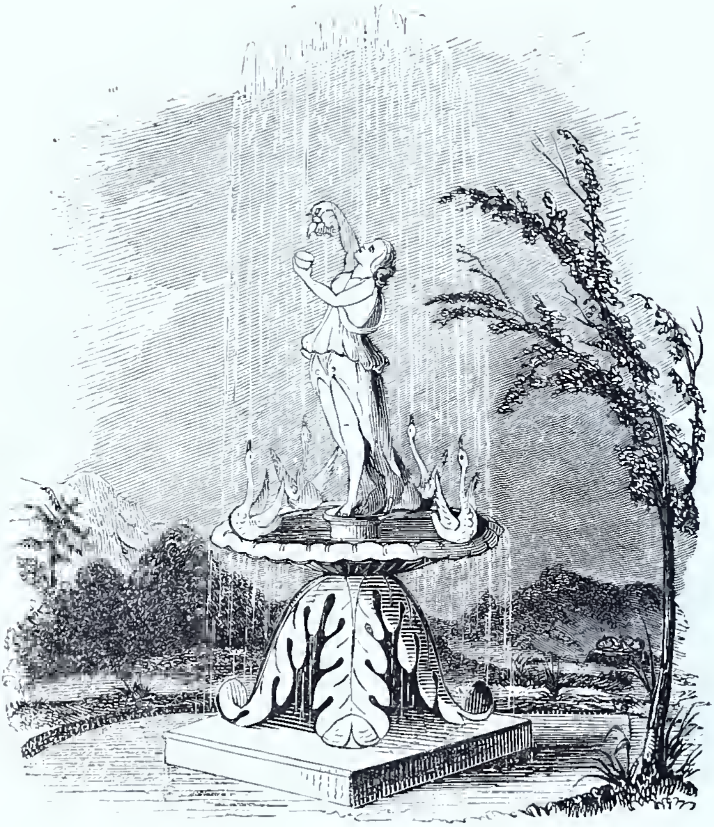
No. 6.—Consisting of a square base, 2 feet diameter—8 leaves supporting a pan 28 inches diameter, and swan 2 feet 6 inches high.

The drawing or cut is a fair representation, except the leaves between the pan and base, which are represented as four only and quite a space between; but there ought to have been eight leaves, rendering the fountain much superior in appearance.—The same error exists in the engraving of No. 7.



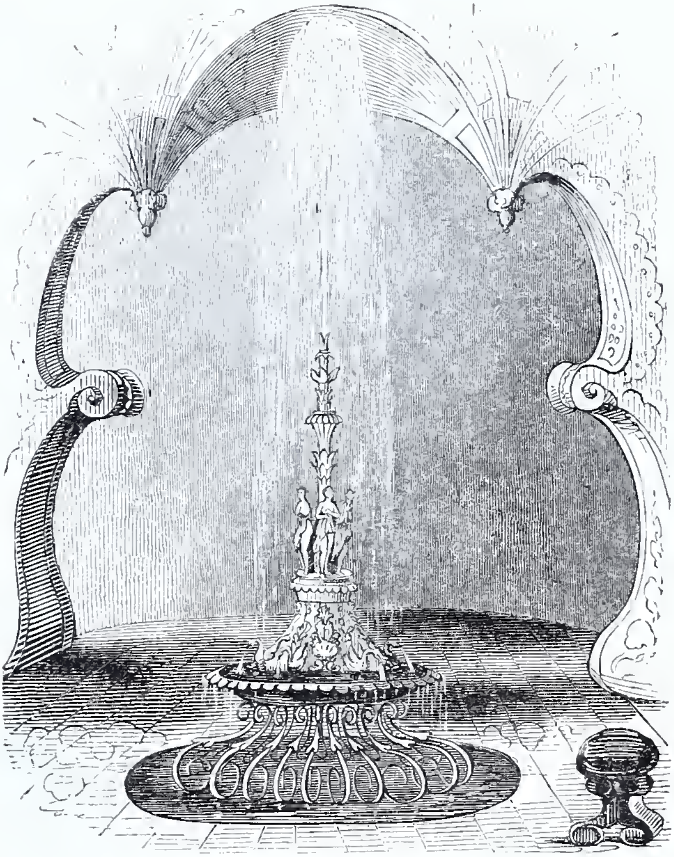
No. 7. $50.

No. 7.—This fountain stands about 5 feet high, consisting of a square base and 8 leaves, same as No. 6; above the leaves is a crown supporting four masks of satyrs, on which is the basin 22 inches diameter, and a large lily surmounted by a small one, from which the centre stream projects. Streams flow from the mouths of the satyrs, which, together with the flow over the edge of the basin and the centre stream, make a very pretty display. It is neat, chaste, and lively.



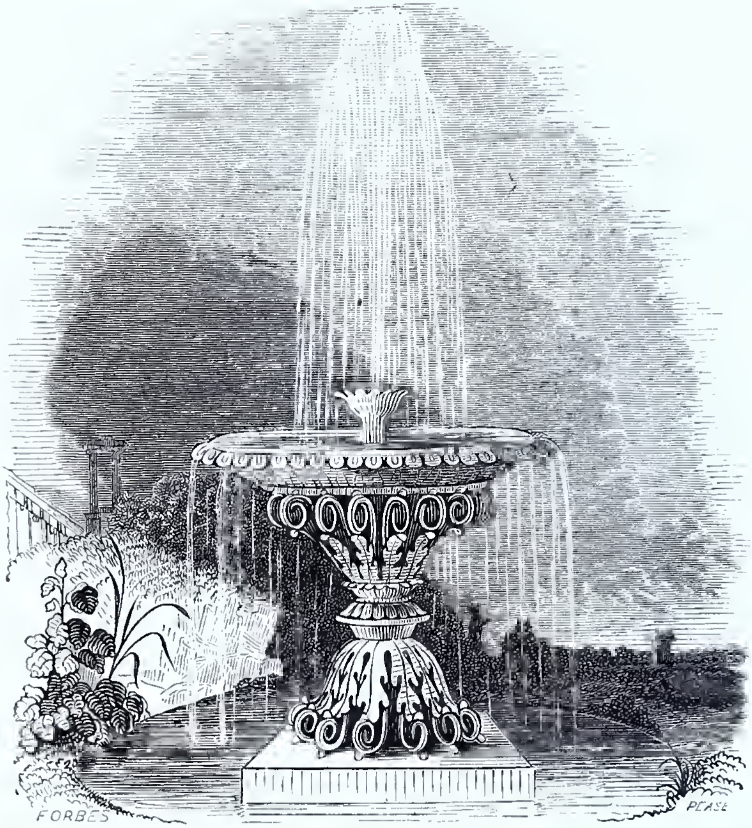
No. 8. $65.

No. 8.—A square base, 8 leaves, supporting a basin same as No. 6. On the edge of the basin are 6 swans; in the centre is a figure of Hebe, (same as No. 4.) All the jets that this fountain presents are from the swans. I have made them with a stream from the pitcher in the hands of Hebe into the bowl; but as the other streams hide this, it becomes a useless expense. The whole height is 4½ feet.



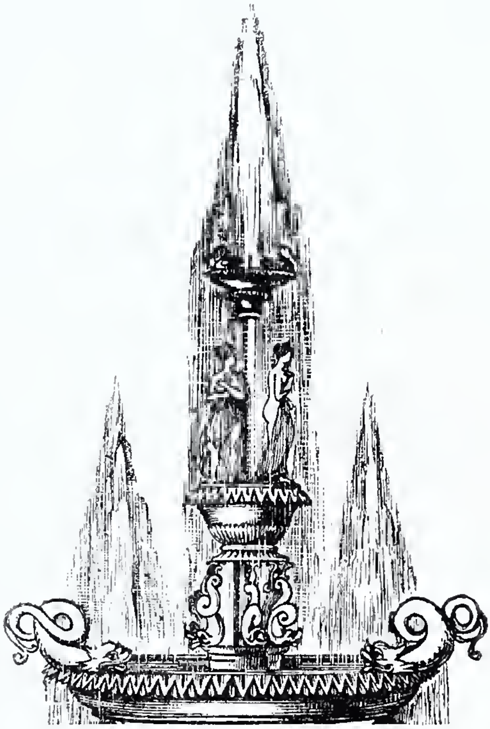
No. 9. $85.

No. 9 represents a scroll base, 5 feet diameter and 6 feet high, supporting a basin 4½ feet diameter. In the centre of the basin is a circle of leaves, rising inclined inward, and supporting an urn, on which, surrounding a column, are three figures of Venus leaving the bath. The column above is ornamented, and between the leaves, immediately above the pan, are 6 small swans, each playing a stream of water into the basin below. These, with the centre stream, form the full display of water. I put up one of this kind in the American Museum, in this city, and it was universally admired.



No. 10. $85.

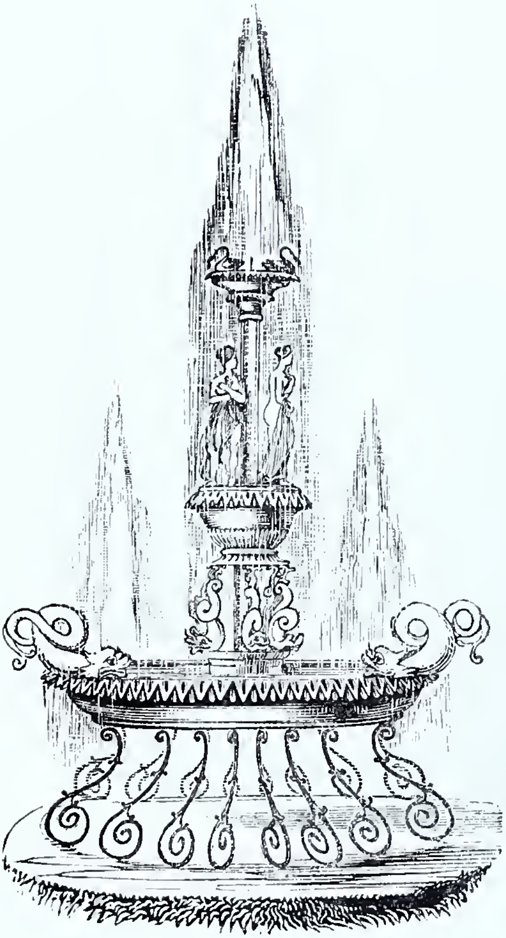
No. 10.—Diameter of the base 2 feet 3 inches ; height to the top of the pan about 4 feet ; whole height 5½ feet. The cut gives a good representation of the general effect of the fountain. It makes a very handsome appearance when put up, and with two good coats of paint a year, its pleasing effect will remain undiminished.



No. 11. $90.

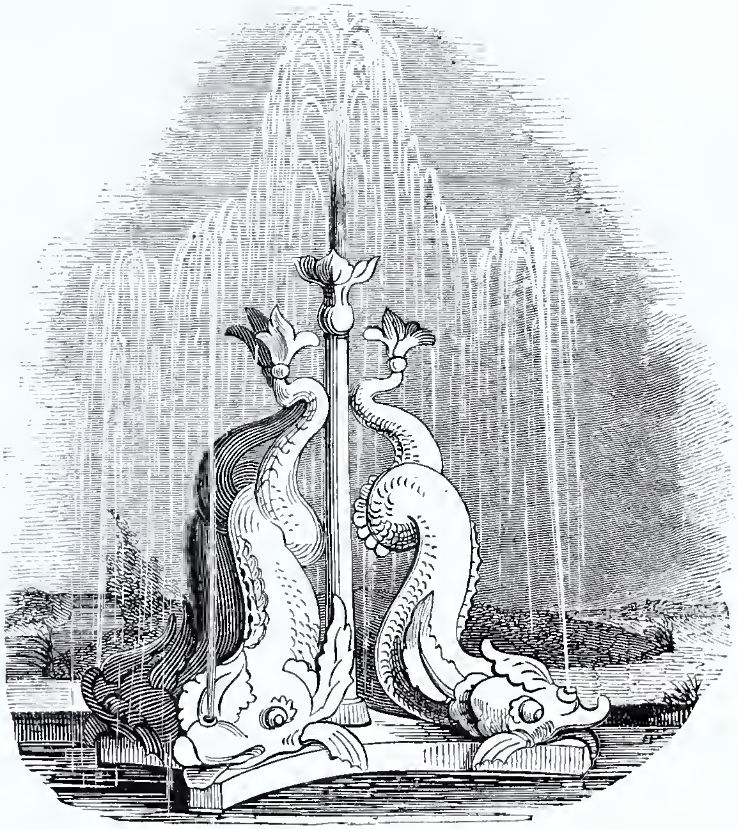
No. 11.—This cut is deficient in not representing the panel base, which may be seen in cut No. 14 under the basin. It is also deficient between the urn and figures, and above the figures some ornaments are not represented.

The basin and dolphins are about 5½ feet diameter, and the whole is 6 feet high. A great number of this pattern have been furnished for various situations, and they have been generally admired.



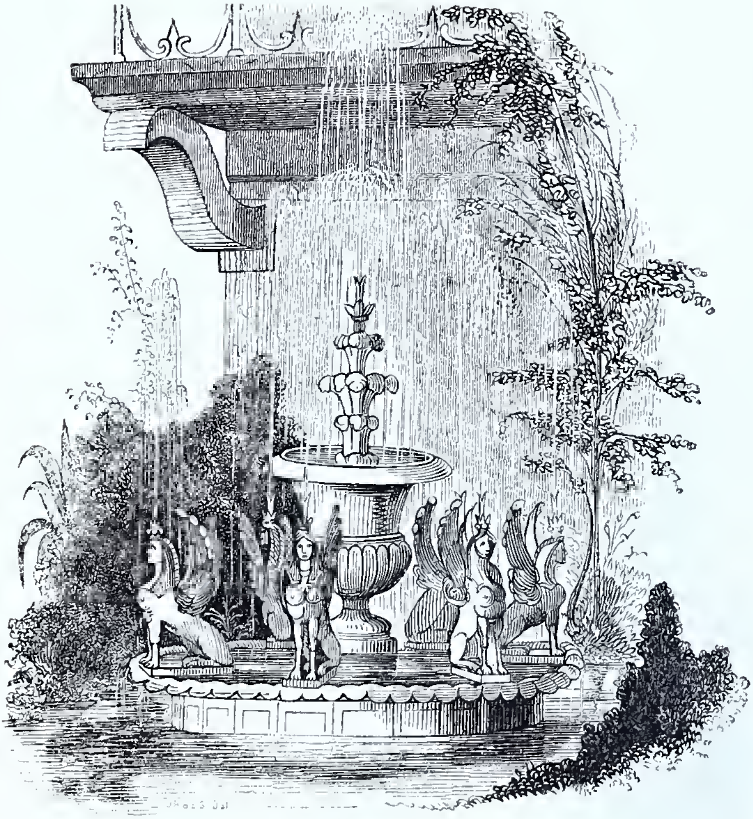
No. 12. $100.

No. 12 is similar to No. 11, but the addition of a scroll base instead of the panel base, raises it up about 12 inches higher than No. 11; and there are some few additional ornaments. The streams are from the 4 Tritons on the edge of the pan and from the lily on the top of the column. Sometimes the small swans on the edge of the upper basin are made to play. This fountain ought to be set in a basin 8 or 10 feet diameter. The height is about 7 feet.



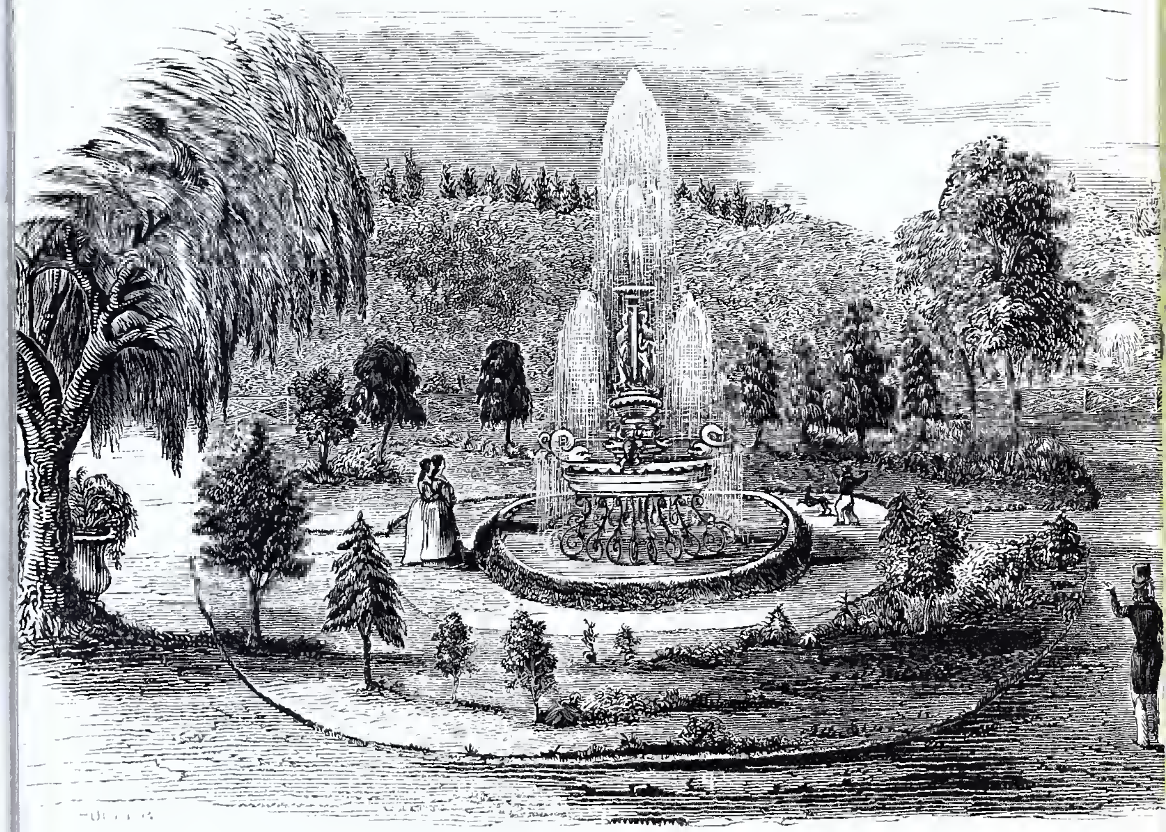
No. 13. $100.

No. 13.—The whole height of this fountain is 5½ feet; diameter 5 feet. Its features are bold, not unpleasant, and present appropriate emblems for a display of jets of water. The dolphin is a classical representation of one of the most beautiful inhabitants of the ocean, and is the most common figure in all ancient fountains. None, perhaps, is better calculated for a point from which to start a jet. This fountain is best calculated for irregular scenery where the immediate landscape is broken, as it presents nothing of the soft and fascinating.



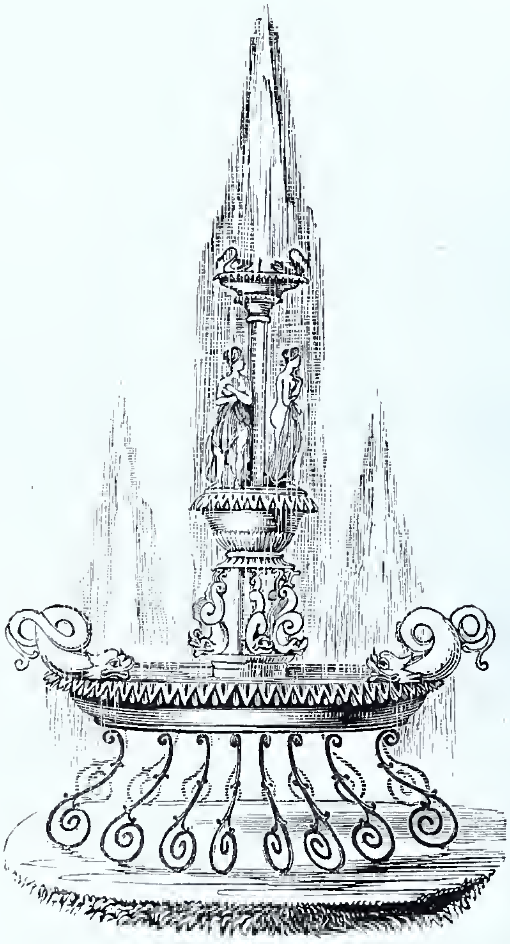
No. 14, $115

No. 14.—A panel base, with pan or basin, supporting on its edge six Sphynxes. These figures are of Egyptian origin, and the lily on the heads forms very pretty starting points for jets. In the centre is an urn like that represented in No. 5, and lilies, leaves, and other ornaments—the whole being 5½ feet high; the base divided into 16 panels, and is 3½ feet diameter. The jets from the centre with those of the Sphynxes form a handsome display of water. This fountain has been very much admired.



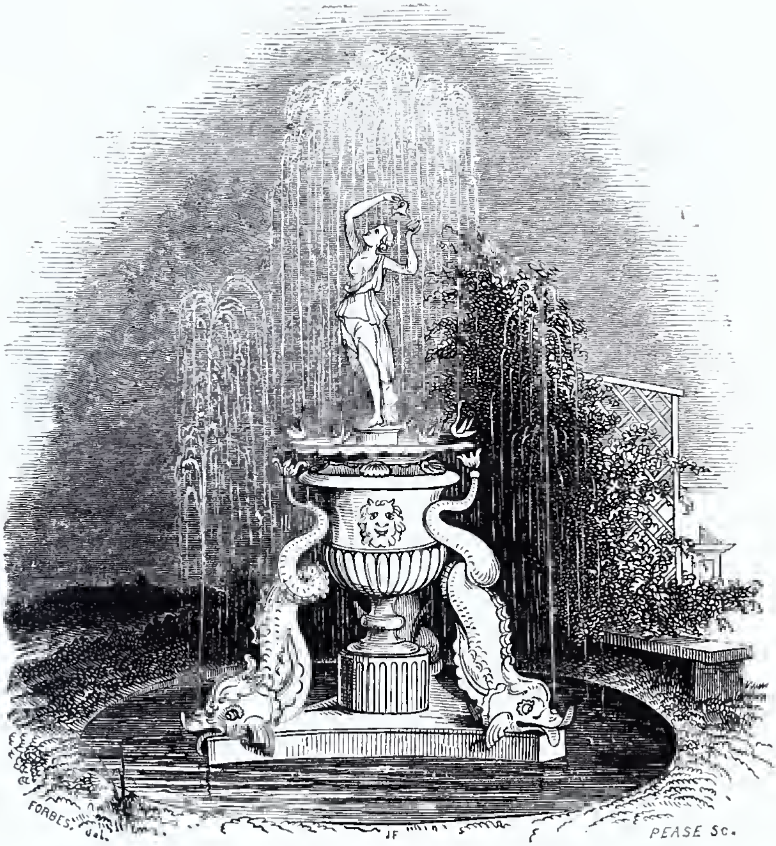
No. 15, $125.

No. 15. This fountain is similar to No 11. It has a panel base, and the addition of a circle of rich ornaments forming the base of the column, which gives some fifteen inches additional height. The cut represents a fountain I put up at St. Ann's Hall, Flushing, L. I. The basin formed on the surface of the ground, the outer circle raised about 15 inches and the bottom about 9 inches; the inner surface coated with hydraulic cement and paved with small pebbles, the outside covered with turf. The whole finished and the fountain put in operation in one day.



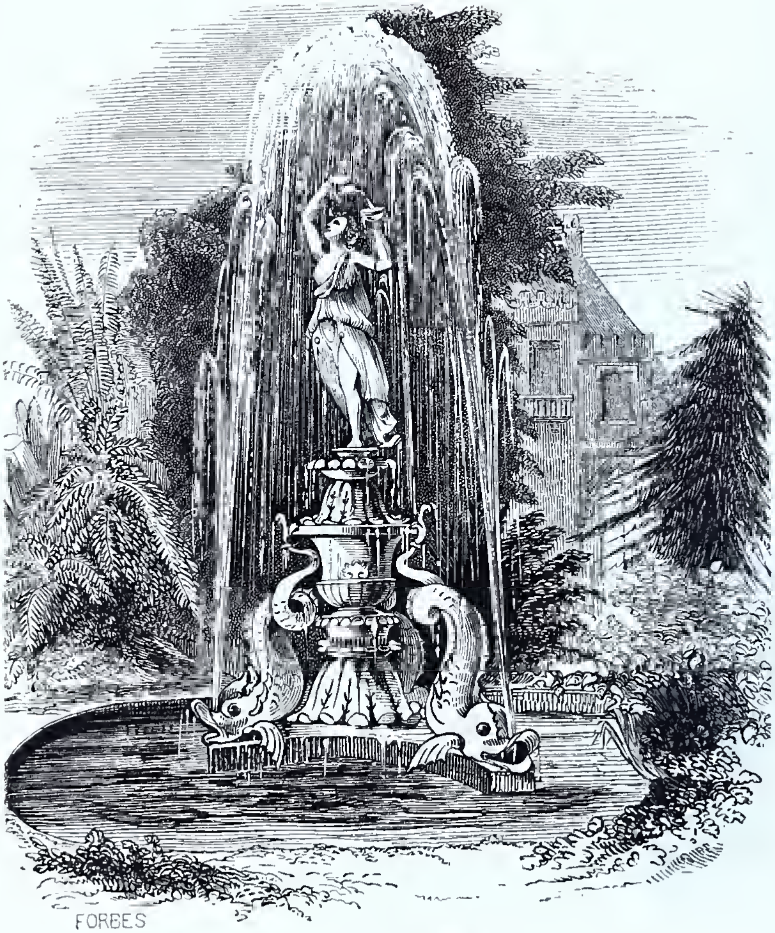
No. 16, $150.

No. 16. Not having a correct cut of this fountain, I give the nearest to it I have. Between the scrolls, under the basin, are ornaments filling the spaces. Above the basin are the additional ornaments as named in No. 15, which with the ornaments on the upper part of the column, present a rich combination of classic figures and carved work. With an addition of water it has a pleasing effect. The whole height is about eight feet.


FORBES, del.
PEASE Sc.

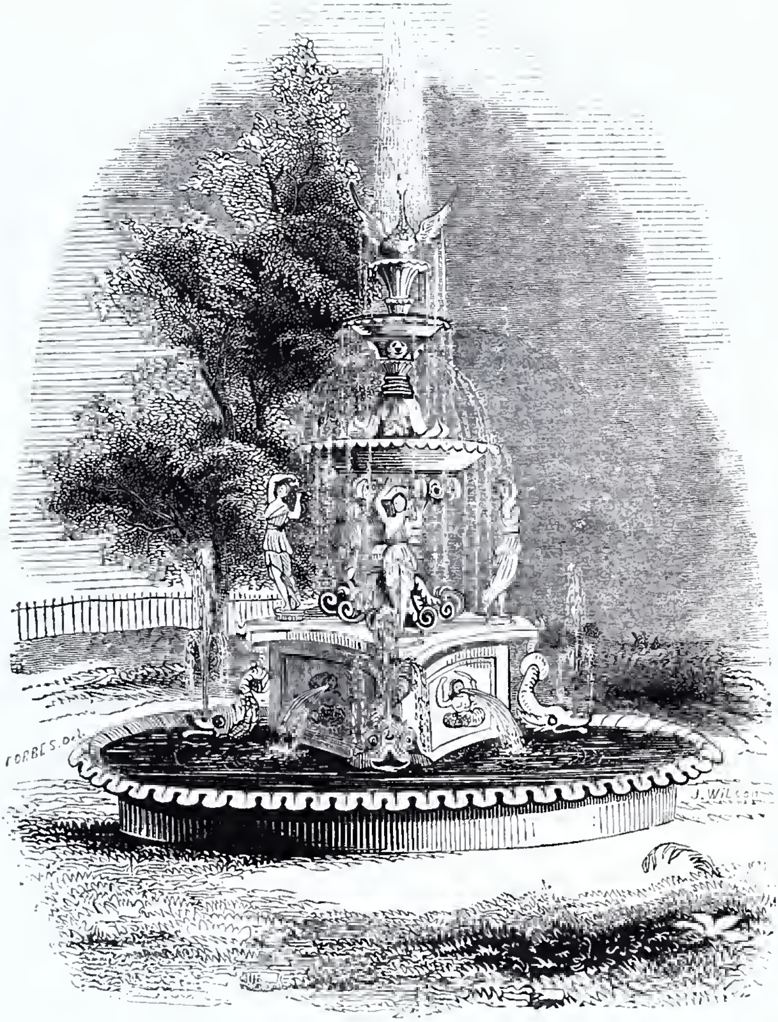
No. 17, $175.

No. 17. This fountain is seven feet high and about six feet diameter at the base. The cut is a tolerably fair representation. The dolphins are three and a half feet high; above the urn is a basin supported by six shells; on the edge are six swans, each playing a stream of water over the figure of Hebe, which with those from the dolphins and streams from the three masks on the urn, give quite a varied display of water. The diameter of the basin for a fountain of this size, should not be less than 12 feet, to produce the full effect.



No. 18, $200.

No. 18. This fountain has a very rich and classic appearance, and cannot fail to strike the attention of observers as combining beautiful proportions and elegance of detail, with sufficient variety to render it pleasing, viewed from different positions, or at different times. It is sufficiently large for any private grounds, the height being eight feet and diameter at the base six feet. The figures on the urn can be masks in the Egyptian style or shells.



No. 19, $1500.

No. 19 Represents a large fountain, for public grounds—height 13 feet, and the diameter of basin 15 feet. When the basin is not wanted the fountain can be furnished for $1000. The diameter without the basin is 10 feet. The engraving does not do the fountain justice, and to those wanting a larger representation I can furnish drawings. This represents the largest I have manufactured, but when desired I can furnish them of any size. I have drawings and plans for them 30 feet high and 25 feet diameter at the base, with figures for side streams that will form a diameter 45 feet.

REMARKS.

The preceding descriptions of nineteen fountains, form but a part of the variety that I have manufactured, but perhaps they combine as much beauty as others that I have no engravings to represent. I have ornamental railing 18 inches high to enclose fountains of any size. This railing forms a very neat and pretty addition. Fountains of iron only require to be properly painted two or three times a year to keep them looking as well as when first put up; after a few times painting so that the iron is *entirely* covered, they want painting only spring and fall.—Iron has decided advantages over marble for a fountain. When water runs on marble for a time it becomes covered with green vegetable matter that penetrates the stone, which when once discolored cannot be again restored to its original beauty; and in northern climates marble is affected by frost so as to scale and injure its beauty. These objections do not exist against iron, while it can be formed into the most beautiful figures at less than half the cost of marble, and boxed and transported at a fraction of the expense. I furnish figures and urns for ornamenting grounds, which when placed on pedestals in situations that will contrast to the best advantage, produce a fine effect.

Fountains will be boxed carefully and forwarded to any part of the world, with all the directions necessary for putting them up. I fit all pipes, brass cocks, jets and couplings to each fountain, so that the connection between the supply pipe and that with the fountain is to be made with one joint only, when the fountain will be complete.

Having embarked extensively in the business and already expended a large amount of money for patterns, &c., I intend to bring the business to as great a state of perfection as possible and am constantly making new patterns, and shall be able to suit the taste of most persons, both in Fountains and Ornamental Statuary.

The following letter (received too late for insertion in its proper place) is from Mr. Bement, who is well known for his improvements in Agriculture, Farm Stock, &c., and as the author of the valuable work "The American Poulterer's Companion." I insert it, knowing that those acquainted with him will have full confidence in his opinion:

BEMENT'S AMERICAN HOTEL,
Albany, Nov. 29th, 1845.

D. L. FARNAM, ESQ.

Dear Sir: In reply to the inquiries contained in your note of the 27th inst. I have only to say, that it is now more than four years since I put one of your smallest size double action pumps in operation at my Three Hills Farm, and so far it has given good satisfaction. It is worked by a water wheel 5 feet in diameter, buckets 12 inches, and throws up over 2000 gallons per day—54 feet high and 700 feet distance.

It has never been out of order, except by accident and the wearing out of the packing. The leathers around the piston have been renewed twice, and the valves once in four years. I can, therefore, with confidence safely recommend it as being well calculated for raising and forcing water, and as durable and less liable to be put out of order than any pump which has fallen under my observation.

I have no doubt with the power I use, it would discharge an equal quantity of water twice the height and distance it now does.

Respectfully yours,

C. N. BEMENT.